INTER AVIA

Review of World Aviation

In this Issue :

Undisclosed Souvenirs from Henri Farman's Diary

The End of the American Airline Crisis — TWA Grows Again

Airspeed A. S. 57 "Ambassador" — Rolls-Royce "Eagle" — Beech Model 34

S. F. Erdmann : The Development of the V 2 — J. Pierrat : Lift Distribution

Sir Alan Cobham : Refuelling in the Air

Mr. Reynolds Flies Around the World

VOLUME II Nº 5 MAY, 1947

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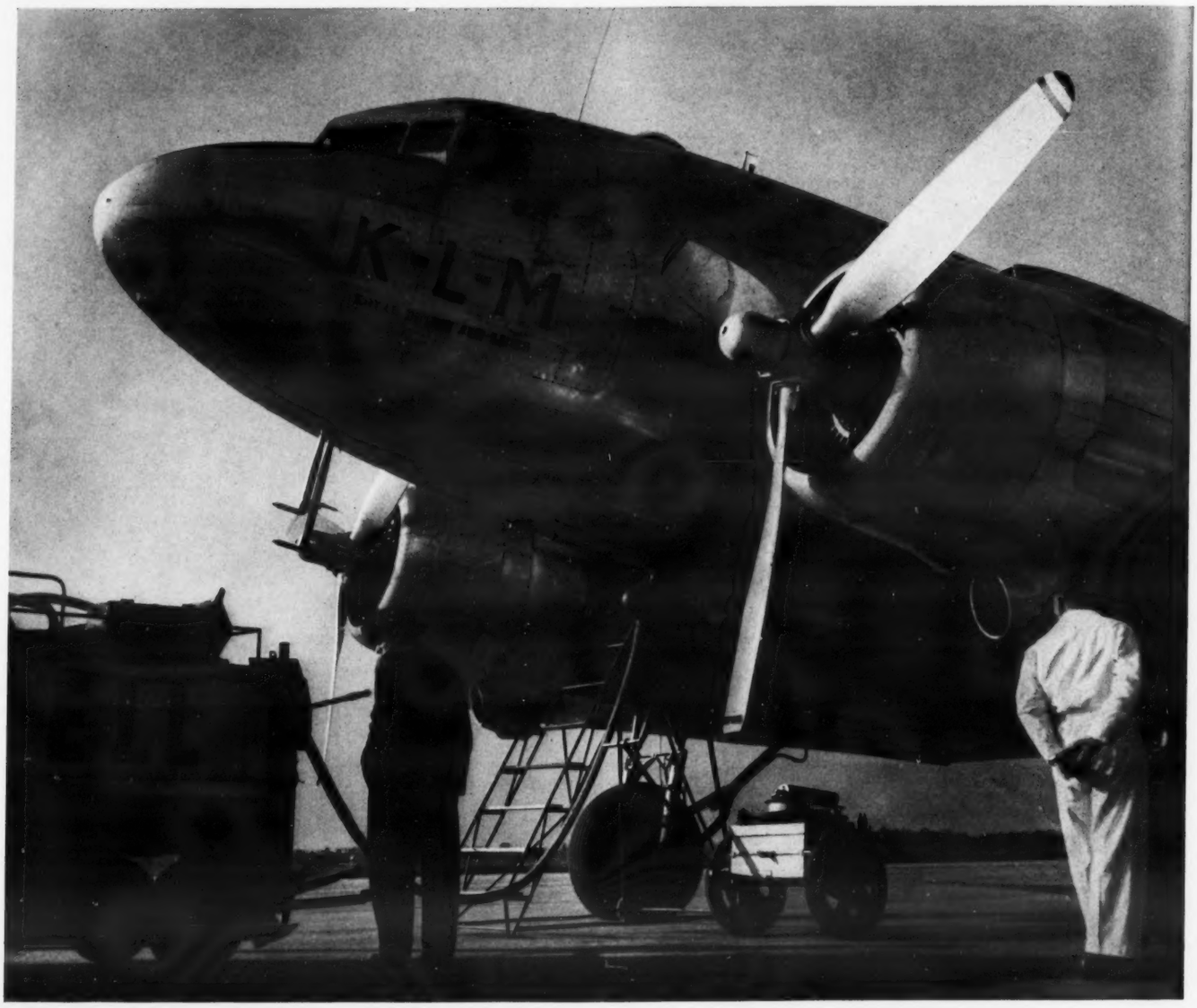

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Review of World Aviation

OFFICIAL ORGAN OF THE FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE (F. A. I.)

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Naval Jet Fighter

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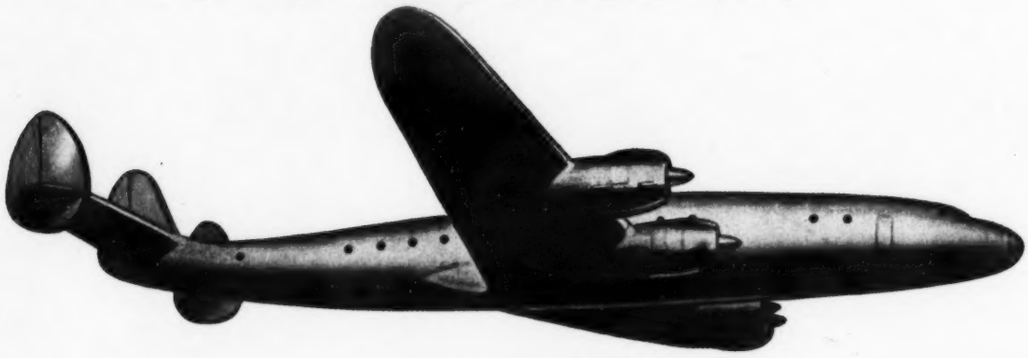

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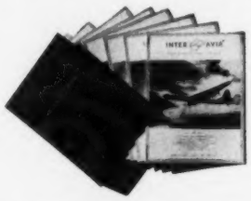

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Binding covers finished in imitation leather with gold lettering are in preparation for the nine issues of "Interavia Review" published in 1946.

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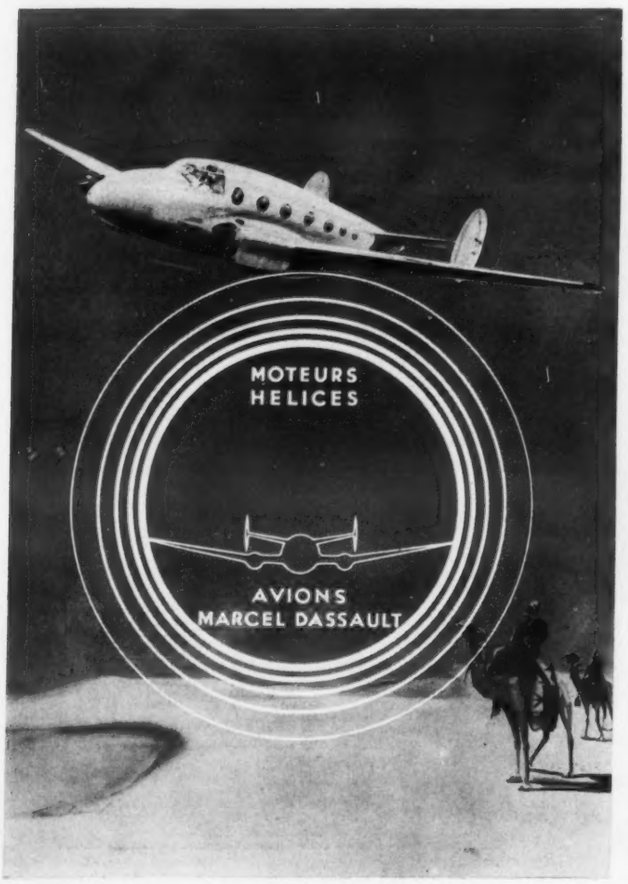

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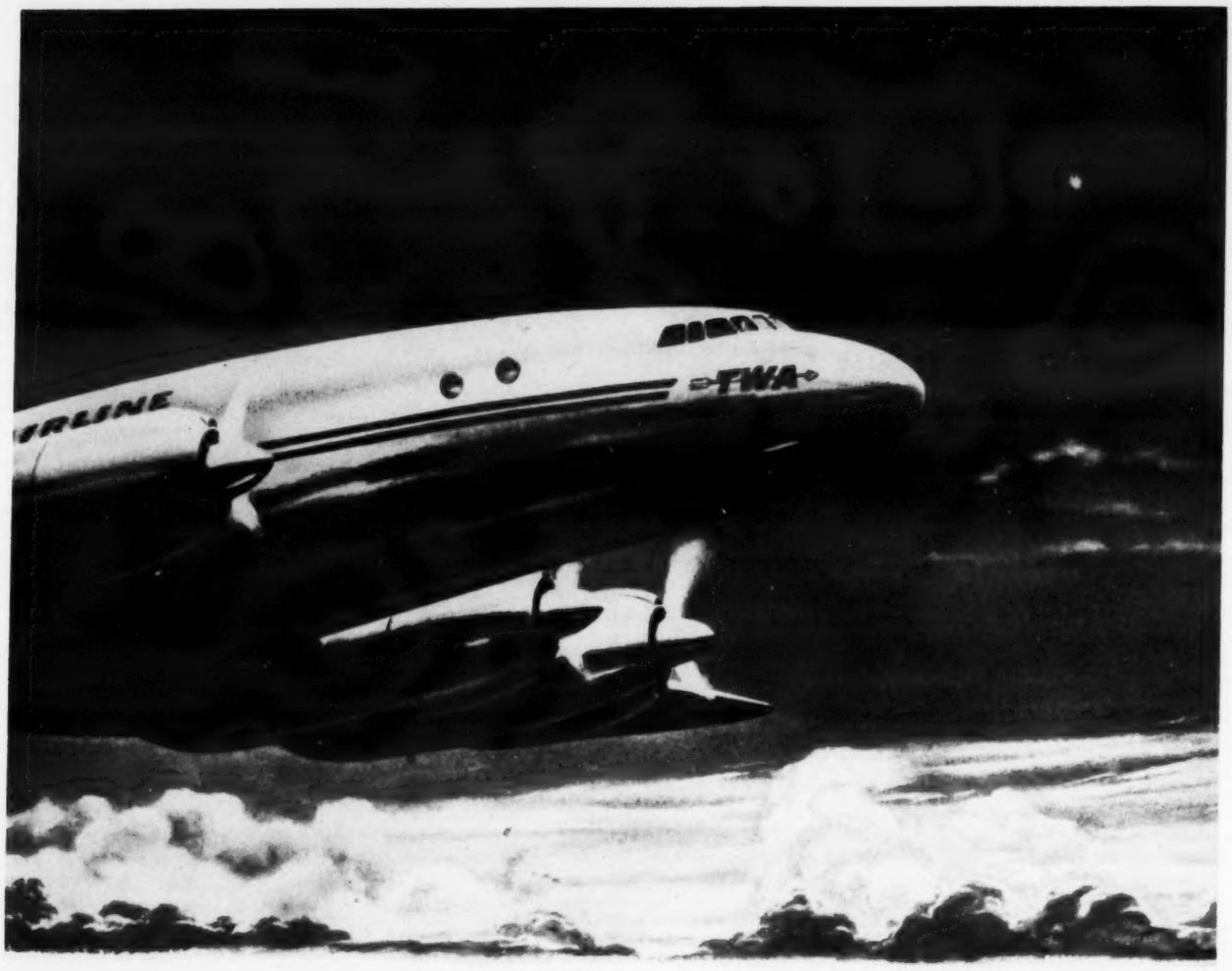

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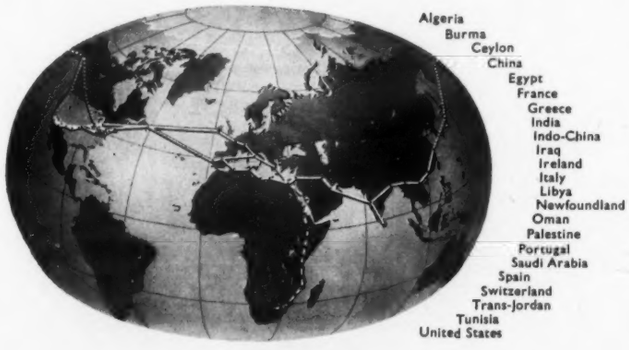

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Connecting airlines : Northwest Airlines — — —
TWA-Route applied for .....

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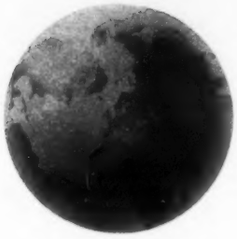


"Will ye no come back agen?"

Just a Postage Stamp

It started with a postage stamp : to be precise, the American postage stamp and its centenary. The Swiss Post Office Administration had decided to take part in the birthday celebrations and to attend the New York stamp exhibition with a newly-issued stamp. Swissair, the Swiss airline company, was given the task of organising a special flight from Geneva to New York.

Whereas Americans and Britons, Frenchmen and Dutchmen, Scandinavians and Belgians, have been spanning the Herring-Pond for some time already, it was Switzerland's maiden crossing. It was up to the Swiss to show that they, too, were technically capable of doing as much.

On May 2nd, at one minute past midnight, a Douglas DC-4 took off from Cointrin Airport, Geneva, with New York as destination. On board it carried a stamp collection belonging to the Swiss Post Office Administration, and a load of 110,000 airmail letters weighing around 2,800 lbs. and representing some $ 75,000. The passengers comprised eight Post Office delegates, three members of the Swiss Federal Air Office's delegation to the ICAO meeting in Montreal, three representatives of Swissair and another three representatives of the press and the radio. There was a crew of twelve, four members of which were Americans, representing the Douglas Company and acting as advisors to the Swiss crew.

The weather situation required that the route be established at the last minute : Geneva—Shannon—Gander—New York. By juggling with the difference in local time between New York and Geneva, the flight was timed so that the postmarks at both ends would bear the same date, May 2nd. However, the weather gods frowned on this philatelic whim. Shortly after the departure from Shannon the weather took a turn for the worse and forced the pilot to fly on instruments. When Newfoundland was reached, the plane had to land at Harmon Field, Stephensville, instead of at Gander. Then La Guardia Field, New York, was closed to further traffic, so that, after about twenty-four hours' flying, the plane had to head for Washington, some 300 miles further away.

Stamp collectors may feel a little disappointed about this, but the Swiss special Atlantic stamp will please them all the same. Swissair had something to be pleased about, too : its crossing was one of the very few successfully-completed trans-Atlantic flights on that particular day. The crew's performance was magnificent.

The Traffic Angle

The landing at Washington was at midnight on May 2nd. As New York had signalled QBI, all air traffic had been diverted to the National Airport : from all directions, American and foreign airliners had converged on the Capitol, where four-engined giants were standing around as casually as tiny trainers do on Swiss aerodromes. And then came the big welcome: after it had stood around for about three hours, the Swiss special plane could finally be attended to ; and the New World's first gesture of welcome was to stick a thermometer in everybody's mouth. The U. S. health authorities had to be sure that all the passengers had been vaccinated successfully against smallpox and that they were not bearers of any forms of contagious disease.—Incidentally, a UNO conference was being held at the very same time in Geneva, to discuss proposals for the facilitation of passport and immigration formalities ; what happened in Washington was a pertinent reminder that radical revision was desirable in this field.—The night-train provided the link with New York.

Will this first visit be followed by a regular calls—a scheduled Geneva—New York service ? Flying the North Atlantic is a big proposition. During 1947 there will be about eighty return flight daily between the Old and the New World. For the participant carriers this means annual expenditures running into millions. A number of the companies flying the North Atlantic have developed into gigantic concerns. The major airlines are capitalised at sums amounting to fifties and even hundreds of millions of dollars. During the war certain of these accumulated huge profits from their operations under contract to the armed forces. Others who did not have this advantage are generously backed by great powers, by colonial empires or seafaring nations. Can a small European state with no outlet to the sea take part in such a competition—for, after all, that is what it amounts to ?

From the technical standpoint, Switzerland can take part ; Swissair is well up to the task. From the economics standpoint, a North Atlantic service could be a source of profit to Switzerland ; and from the prestige standpoint, such a service would be highly desirable. But whether it would pay its way during the very first years is doubtful. Two return flights weekly signify an undertaking which can be expressed in millions annually. The decision does not lie with Swissair, nor with its management ; it does not lie with the airminded Swiss citizen. It lies with the Federal government and depends on the national treasury.

The Political Angle

Little man, what now ? The Swiss visitors, representing Swiss aviation, sat at a table in New York and talked shop with the "big shots" of American flying. Toasts, promises... aeronautical jargon : aircraft to measure, collaboration—everybody was very amenable. The American is not afraid of competition ; it is daily bread to him, particularly when it comes to aviation.

Traffic politics ? Two democracies which have much in common and, as a matter of fact, differ only in size and language : will they add new relations to those already in existence ? A small country, the "playground of Europe," which has so often willingly played the part of a mediator : will it contribute towards throwing another bridge from the East to the West ?

Politics proper ? Politics are alien to real aviation. Commercial air transportation is a business and not the instrument of political intrigues.

EEH

Forty years ago, one kilometre in a closed circuit represented a world aviation record.

Undisclosed Souvenirs from Henri Farman's Diary

COMPILED BY LUCIEN ADÈS.

Seated in Henri Farman's study, I faced the great aviation pioneer across his desk: "Mr. Farman, I would like to hear about your first aviation record; the one which proved conclusively that an aeroplane could take off, fly, turn and land, and which won you the Deutsch-Archdeacon prize of 50,000 francs. Tell me in your own words the story of the first kilometre flown in a closed circuit."

Like myself, when I made this request, you probably think that there is nothing you do not already know about this flight. But I am sure that some of the great man's revelations will come as a surprise to you too.

Closing his eyes for a brief instant, Henri Farman rolled a cigarette, sealing it by an almost imperceptible movement of the corner of his mouth. At that moment he looked just as he does in the portraits and photographs which we have seen during the past forty years. His nose has lost nothing of its subtle irony and his mouth still retains its rare sensitivity. As he opened his eyes again and looked straight at me, I knew that I was to get a true, unvarnished account of his adventures.

1935: Henri Farman with another flyer, Cognot, prior to a test flight of Farman's 1 000-I stratospheric aircraft.

At the time when I first became interested in aviation I was over thirty and financially more or less secure. My first passion had been for bicycles, then for motor cars; and two garages in London and Paris which I ran in collaboration with my brother, Maurice, had brought in a fair amount of money. Around 1905 nobody had flown properly—that is to say, flown in the modern sense. It may sound somewhat commonplace, but, like so many others at that time, I was simply burning with the desire to rise from the ground by some kind of mechanical means, even if only for a short instant. I must say that I cannot help becoming sentimental when I recall our very first attempts, which, if repeated today, would serve merely to cover us in ridicule. The first pioneers could hardly be classed as children, but we had a feeling that we were acting like them. I can still see myself, bent double under the weight of immense wings and harnessed like a plough-horse, waiting my turn to jump into a stone quarry near Billancourt. I still fail to understand how, equipped in such a manner, we managed to pluck up enough courage to jump into a hole some fifteen to twenty feet deep, and how we ever emerged from our adventures without breaking every bone in our bodies.

But we had to fly at all costs, even—I do not mean to be grandiloquent—at the cost of our lives. The stories that were circulating at the time about the Wright brothers fired our imagination. It was maintained that those two youths from Ohio had built an engine-powered machine in which they had managed to leave the ground, fly and land safely. They had surrounded their invention with the strictest of secrecy and, according to themselves, would only disclose its details in return for one million gold francs, guaranteed by a Government. Thus they toured the world's capitals to sell their invention to the highest bidder; and they remained well in the public eye long after the time of which I am speaking. We had already effected a number of fairly lengthy flights in France, but the Wright brothers continued to fill the newspaper columns, giving interviews, spreading rumours in order to deny them afterwards and, above all, showing the highest disdain

Henri Farman in 1907.

for all aeronautical exploits but their own.

Take, for instance, an article entitled "The Wright Brothers in Germany," which appeared on October 21st, 1907, in the Paris *Journal*: "The Wright brothers, inventors of the dirigible aeroplane (sic), are at present in Berlin," and that "the most varied rumours are circulating in this connection. It is understood that they are selling their invention to the government, or to a German syndicate, for five million dollars." Then, "they deny reports to the effect that they have already sold it to an Anglo-American syndicate for twenty million marks." (Note that the Germans were to pay in dollars, the Americans in marks!) They asserted that "trials with their dirigible had produced most satisfactory results. It had flown for thirty-eight minutes and three seconds against an eighteen-kilometre headwind, and would have remained aloft for much longer had the fuel supply held out. In all, it covered thirty-nine kilometres."

Meanwhile, however, there was never a live witness to testify to these claims; not even any kind of photographic proof. Admitting that their claims were based on fact, the performances indicated were, of course, absolutely extraordinary for the time; and the Wright brothers' judgment of our few modest

exploits, achieved at the price of unceasing effort, is readily understandable : "As regards Mr. Henri Farman's aeroplane, they willingly recognised its qualities, but declared that they themselves had attained the same results five years beforehand."

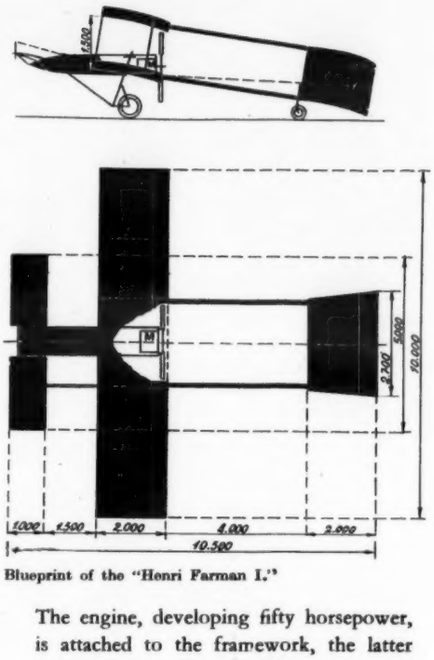
Unfortunately, however, nobody but the inventors themselves could ever testify to the veracity of the Wright brothers' claims ; but, even assuming that these were somewhat exaggerated, one thing is sure, namely, that the Wright brothers had at least the ingenuity and courage to conceive and build an aeroplane in secret, and to fly it without bursting with pride and showing it to everybody. Whether their actions should be attributed to stubbornness, avarice, phlegm or disdain, or a little of all four, I find it hard to say. That stubbornness constituted a substantial part of their character, I can state definitely. Long after it had been proved clearly that an aeroplane had not only to fly, but also to taxi along the ground, in order to fulfil its function as a means of transport, the Wright brothers categorically refused to abandon their launching-rail principle which constituted a 100 per cent handicap to ground manoeuvres of their aircraft. Their difficult character earned them a certain amount of ingratitude in the U. S. A., which perhaps they did not deserve. The Americans, who customarily go into almost puerile raptures over their champions, accorded the Wright brothers the coolest of academic respect. However, the brothers returned the compliments ; and when Wilbur, the elder of the two, died, Orville preferred to offer the historic aeroplane to England rather than to America.

My first Aeroplane.

In 1907, after much elementary theoretical work which I was able to carry out with Archdeacon, and numerous practical tests with gliders and scale models, I decided to ask the Voisin brothers to build me an aircraft for more serious trials ; the airframe was to be derived from the "Chanute" and it was to be powered with the famous "Antoinette" fifty-horsepower engine, designed and built by Levasseur at the Gastambide works. Though this engine was the ***non plus ultra*** of its day, its conception and manufacture was most primitive. Primarily a nautical engine, it had no carburretor, so that the fuel flow had to be regulated by means of a throttle flap ; its specific weight worked out at about two kilogrammes a horsepower. Well, the Voisin brothers went to work and, in a few months' time, built the biplane with which I was to win my laurels.

You may ask what my "Henri Farman No. 1" looked like. It is difficult to describe it in the terms which we have acquired during the past forty years, so that the best you can do is to look up its description in the *Journal* of August 18th, 1907 :

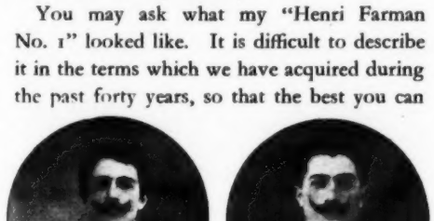
> "The new aeroplane is a cellular biplane. The central cell is ten metres long by two metres wide, and is formed of two surfaces located at two and one half metres apart. This cell is connected to a special framework construction of four and one half metres in length, to which is coupled a rear cell measuring six metres by two.



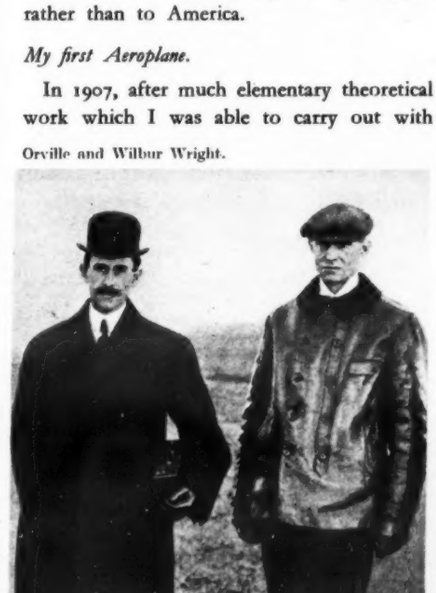
Blueprint of the "Henri Farman I."

The engine, developing fifty horsepower, is attached to the framework, the latter being of oak. The propeller, of two and one tenth metres in diameter, gives the aeroplane a speed of fifty kilometres an hour. The total area of the aeroplane measures fifty-two square metres and the total weight, including the pilot, five-hundred kilogrammes. The entire apparatus is supported on an undercarriage with steerable wheels, which allows for safe landings even in a case of a side wind. Mr. Farman placed a directional rudder at the rear and an elevating control surface in front . . ."

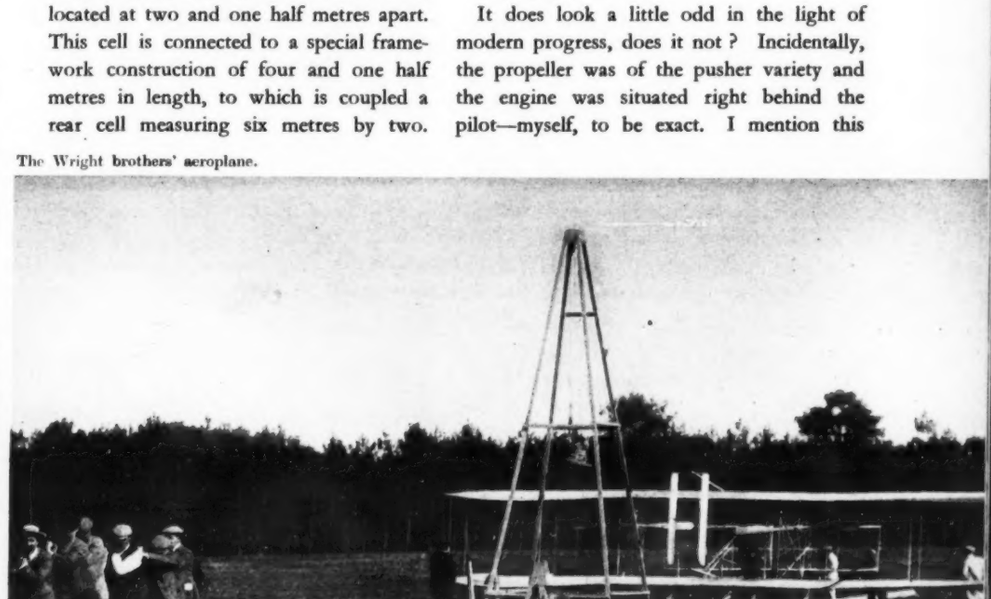
It does look a little odd in the light of modern progress, does it not ? Incidentally, the propeller was of the pusher variety and the engine was situated right behind the pilot—myself, to be exact. I mention this

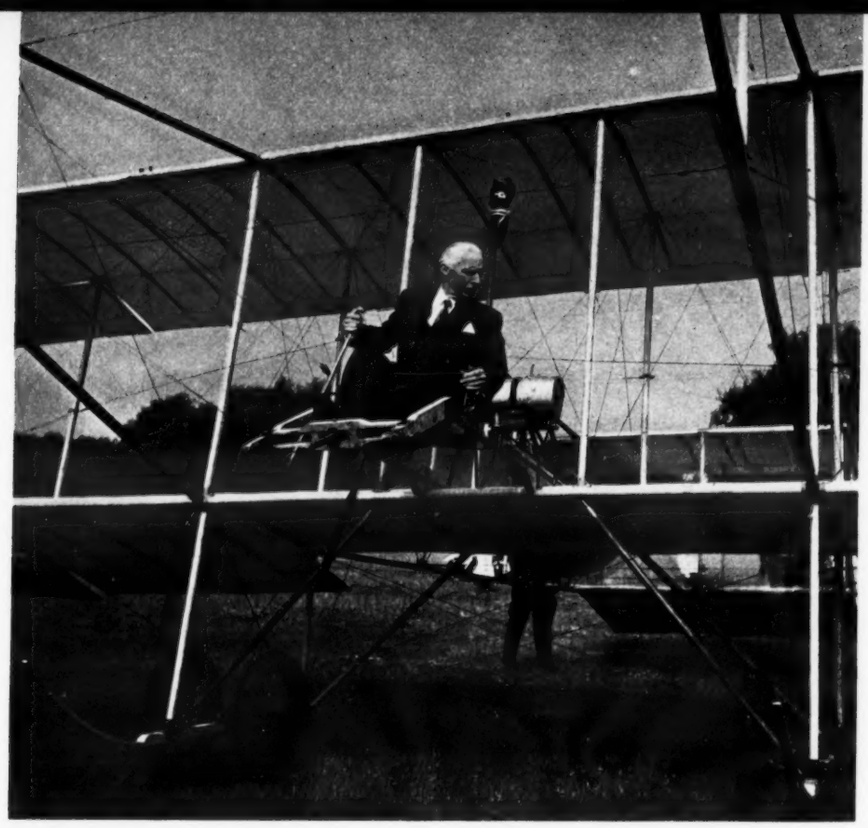

Gabriel and Charles Voisin.

Orville and Wilbur Wright.



The Wright brothers' aeroplane.





Henri Farman, aged seventy, at the controls of his "Henri Farman I."

fact because it was of certain consequence to me one day when a sudden shock caused the entire engine to break loose from its supports ; the mains haft bored a neat, round hole in the lower part of my back. Luckily enough for me, I did not lose a single drop of blood.

In contrast, another detail of the construction proved useful. The undercarriage struts were each composed of two rods surrounded at the summit by coil springs, which came to lie on either side of the cockpit. As I taxied along the ground, the whole bus wobbled fearfully, and I shall tell you later of the part which those two struts played in my first jump into the air, and of the controversies which ensued in consequence.

Around 1906, it was the opinion of the authorities that anyone who flew—or rather, attempted to fly—was a complete lunatic. Aware that one should not oppose lunatics for fear of their becoming still more dangerous, the worthy Paris officials allowed us to pursue our efforts, but under the following conditions : the candidate had to obtain a written permit from the authorities before he could try out his machine on the Bagatelle meadow (it's hard to believe that this charming spot, in view of its name, could have been chosen by mere chance). Then, with his permit in his hand, the candidate had to bring the component parts of his machine, assemble them there on the spot, do what he wanted to do, take the whole thing apart again, and leave ; all this had to be done within a specified time, between the hour of midnight before the test, and noon of the next day.

You see the sort of help we got from the authorities, and why the pioneers at the beginning of the century made such startling progress !

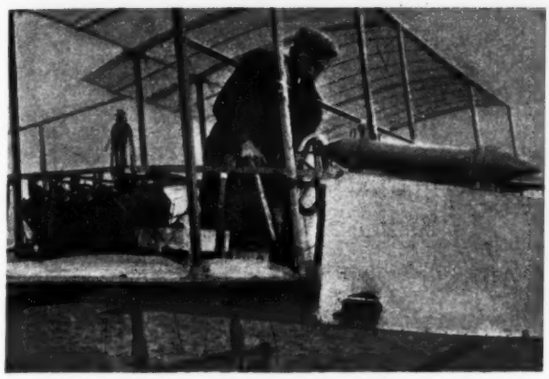
In reality, the entire cause of this inanity on the part of the authorities was the following : apart from a few fanatics, nobody believed in there ever being any possibility of directional flight in a machine which was heavier than air. Celebrated engineers had effected infallible calculations in wind tunnels and had come to the conclusion that flying was impossible. They publicised a verdict that the whole idea was based on pure fantasy and, furthermore, was an absolute waste of time ; unfortunately, many people, including several intelligent ones, lent an attentive ear to their mathematical balderdash.

Once the Voisin brothers had got down to work and we had firmly resolved that nothing would stop us from carrying out frequent and serious tests, the problem arose of how to obtain the use of a decent flying field without having to go through the Bagatelle pantomime. After numerous requests and stubborn arguments we finally obtained permission to use a field at Issy-les-Moulineaux and, topping it all, to erect a small wooden hangar for sheltering our apparatus. Subsequently, however, the authorities, presumably aghast at their own generosity, decided that this was perhaps making it too easy for us : the field in question was surrounded by a low, stone wall ; and the site of our projected hangar had to be on the other side of this wall. Therefore, in order to reach the field, we had to climb over the wall : an easy matter for us, but somewhat complicated for our cumbersome flying machine. The obvious solution, of course, was to knock a hole in the wall ; but the official guardians of law and order kept a vigilant eye on our proceedings. The way they watched that wall, one might have thought they were safeguarding the last rampart of civilisation against the assault of the Barbarians. Well, where there's a will, there's a way ; and before each of its daily ordeals, the poor, old "Henry Farman I" had to strain its limbs in the manner shown in the accompanying photograph.

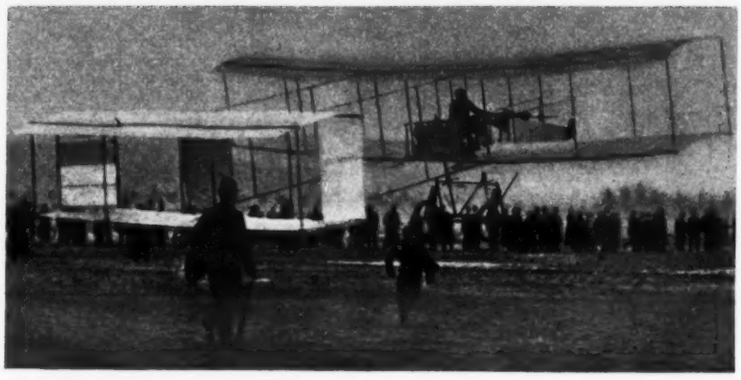
Learning to Fly.

And finally we got down to the tests. Until my dying day, I shall never forget a single detail of those exciting moments. Our ardour, enthusiasm and faith ought, in my opinion, to have sufficed better than any engine on earth to lift the aeroplane from the ground. The sun rose and set without our leaving the field. Hour after hour, day after day, we tried again and again. Our hearts beat at a rhythm a hundred times faster than that of the engine, as if to put it to shame, to urge it on ; our legs ran faster than the undercarriage wheels, as if to set them the example.

The "Henri Farman I" had to climb over the wall every day.



The "Antoinette" engine directly aft of the cockpit.



The record plane skims over the ground.

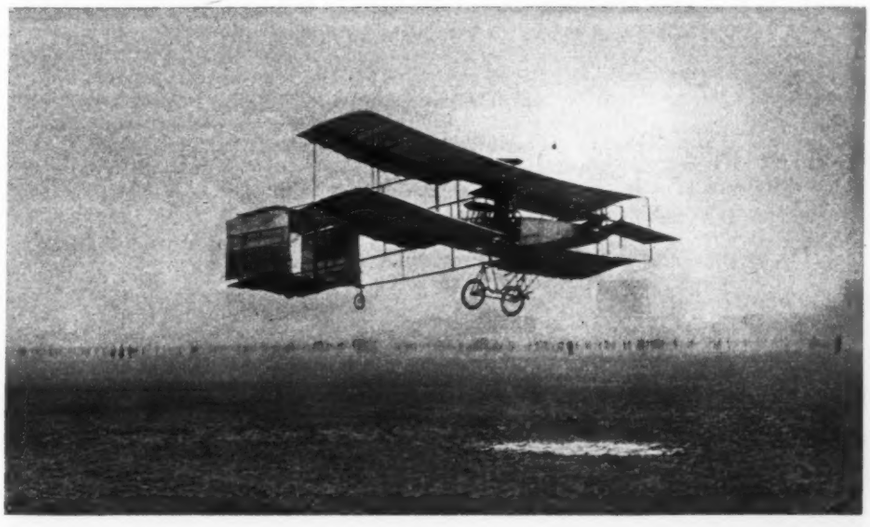
During the course of those trials, I taxied along the ground more than I ever did during all my subsequent career as an aviator. The Voisin brothers ran, or rather walked, alongside the aeroplane, showering me with good advice ; they would lie down flat to see whether the wheels left the ground by a few millimetres. We let out yells of joy every time the machine seemed to jump, and groans of disappointment on perceiving that the cause was only a big stone.

The "Henri Farman" proceeded back and forth, back and forth, from one end of the field to the other, at the stately pace of a grazing cow. The engine spluttered, coughed and spat ; the aeroplane staggered, bounced and shuddered ; but it simply would not take off. In the evenings, we bent over the plans, altered a detail here and there, thus gradually discovering the principles of aerodynamics. As I said beforehand, nobody had really flown at that time ; so that nobody was capable of stating precisely what was necessary in order to achieve powered flight. We had to learn everything ourselves ; in fact, discover everything. The only flying rule about which we were absolutely certain, and which we applied sedulously, turned out to be a *mistake* ; and it was only by a lucky coincidence that we were able to find this out. This is roughly how it happened :

Everybody engaged in aviation at that time was convinced that a perfect similarity had to exist between an aeroplane and a kite. The airframe constituted the kite proper, and the engine fulfilled the function of the string. With this principle in mind, we put the aeroplane in a rearing position as soon as it started moving, and we held on to the stick like grim death, not relaxing it a fraction of a centimetre. Of course, the engine was far too feeble to drag the machine into the air, in view of this wrong position, so that if we had kept this procedure up, we could have grown old and grey before attaining any effective results

Thus it so happened that one day, after taxiing unsuccessfully for several hours, and exasperated by the incessant bouncing of the undercarriage struts at my sides, I let go of the stick to press down as hard as I could on the springs in order to stop their antics. And this ridiculous impulse contributed immeasurably to the development of aviation. Finally liberated from its cramped position, the aeroplane taxied forwards a few metres in complete freedom and, for the very first time, *took off* . . . to rise a few centimetres.

Braving the elements in 1908.



I had accomplished my first aerial hop, and my enthusiasm knew no bounds. Those who witnessed it, as soon as they had overcome their amazement, started jumping around and wildly yelling with joy.

But, the very next day, the trouble started. I had not even fully tasted the joys of my first success after so many months of fruitless effort, before I had to start fighting against idiotic criticisms by the newspapers. For instance, one bright journalist wrote in *La Presse* that the few hops which I had accomplished had been entirely due to the muscular pressure I had applied to the two undercarriage struts (as described above). You only had to take into consideration that my aeroplane weighed over five hundred kilogrammes, in order to obtain an idea of how much the public of that time understood about aviation.

However, we too had still to learn the full import of this fortuitous occurrence. We were so convinced that our earlier reasoning was right that, the next day, we started our trials again where we had left off, that is to say, with the control surface up for the take-off. As was to be expected, the results were negative.

Another stroke of fortune had to intervene a few days later in order to rid us of this fallacious idea and to teach us the first elementary principle of flight.

As usual, I was taxiing along with the joystick pressed against my stomach and the aeroplane's belly, alas, still earthbound, when a storm suddenly threatened. The others signalled to me to make for the hangar as quickly as possible, to shelter the aeroplane from the wind and the rain. I was at the far end of the field and started to move forwards as fast as I could go, all the time, of course, without attempting to take off. For this purpose, I let go of the stick, thus no longer shackling my machine. And then, just as the storm started to raise the first clouds of dust, the miracle happened again. I took off, flew several metres, landed, and took off again, accomplishing several good hops at about eighty centimetres from the ground.

(To be continued.)

A *Douglas DC-4* of TWA flies over Rome before landing at Ciampino airfield.

TWA Grows Again

On September 20th, 1945, a four-engined Douglas DC-4 coming from New York landed at Orly airfield, near Paris. The first survey flight of the new International Division of Trancontinental and Western Air, Inc., now better known as Trans World Airline or TWA, was completed. The flight was under the direction of General T. B. Wilson, at the time Chairman of the Board of TWA and Managing Director of the Division, who spent much of the remainder of 1945 arranging operating rights, agency agreements and landing facilities in war-torn Europe. On February 5th, TWA inaugurated the first regular commercial post-war landplane service between the New World and the Old : a plan discussed for years had come true.

Since that date TWA has never ceased to expand its services across Continental Europe, first from Paris to Geneva, then to Rome, Athens and Cairo. So much was the company in the news that TWA, or "Té-Vé-A," became a household word in the European countries through which it flew and quite generally meant "American air transportation."

But suddenly the airline seemed to run into difficulties. In August, 1946, its Lockheed "Constellation" four-engined high-speed airliners, with which it had become closely identified, were grounded by the C. A. A. because of some small mechanical "bugs" that always crop up in new aircraft types. In October of the same year, TWA's pilots went on strike and stayed out for nearly a month, causing considerable financial loss. TWA had to launch a programme of retrenchment : it laid off personnel, cancelled contracts for over twenty "Constellations." The financial difficulties that became inevitable as a result of these set-backs produced divergencies of opinion in the management, the upshot of which was a complete change of the Board of Directors in the weeks leading up to April 24th, on which date a new management was appointed.

TWA now was in the public eye again, though in a less favourable light. People began to gossip, and all sorts of unfounded rumours were spread, some of which may have been launched with ulterior motives. Nobody in close contact with the air transport business set any store by them, however, for those familiar with the sound foundation and the irresistible growth of the company knew that TWA would weather the storm.

Transcontinental & Western Air is the outgrowth of a tiny one-plane operation which had its inception in 1926, when enterprising young men filled with confidence in the coming "Air Age" turned to flying as a career.

One of these young men was Oklahoma-born Jack Frye, who had his first taste of aviation when three old Army aircraft landed on his father's ranch in the Texas Panhandle in the winter of 1918. In 1923, when he was eighteen, Jack Frye journeyed westward to Los Angeles, and from his meagre salary as a drugstore clerk he saved $ 5.00—enough for one ride in an aeroplane. He liked it and continued to fly, progressing rapidly and soloing after seven hours. When he had logged 7½ hours, his instructor allowed him to turn instructor himself and made him a partner in the flying-school. Among his first students was Paul E. Richter, who felt the same urge to fly.

In 1926, Frye and Richter, together with the late Walter A. Hamilton, formed the *Aero Corporation of California,* with Frye as President and Richter as Vice-President.

With an initial capitalization of $ 5,000, they launched into practically every phase of flying activity : they ran a flying school, a maintenance and service station and an aircraft sales agency. In 1927, they formed *Standard Airlines,* with Frye at the head of both the new and the parent company. With one single-engined Fokker, Standard

Going out : Some of the top executives that have left TWA. — *Left : Jack Frye,* creator of TWA, resigned as President last February after differences of opinion on policy with Howard Hughes, controlling stockholder. — *Centre : Major-General Benjamin F. Giles,* former Vice-President and Africa-Middle East Director of TWA. *Right : Brigadier-General Arthur R. Wilson,* former Vice-President and European Director of TWA.

Airlines operated a route between Los Angeles and Phoenix, and later to El Paso.

Meanwhile, other airlines were entering the industry. Jack Maddux, a Los Angeles automobile dealer, formed *Maddux Airline*. *Western Air Express,* the most profitable line of the time, was expanding rapidly through the West and Southwest. And on July 7th, 1929, *Transcontinental Air Transport,* known as the "Lindbergh Line," was formed and operated America's first combination air-rail service over a coast-to-coast route close to the present TWA system.

A somewhat confusing series of mergers and transactions soon followed. TAT merged with Maddux Airlines. Standard Airlines, Jack Frye's first company, was sold to Western Air Express and Frye himself became the latter's Vice President of Operations. On October 1st, 1930, the system today known as Transcontinental & Western Air, Inc., was finally formed : TAT-Maddux acquired the Kansas City—Los Angeles route from Western Air Express and was renamed TWA. Frye became Vice-President of Operations of TWA, under H. M. Hanshue, the first President.

The combination air-rail service was abandoned at the same time, and on October 25th, 1930, TWA inaugurated America's first trans-Continental air service. Passengers flew from coast to coast in 36 hours, with an overnight stop at Kansas City. Soon, however, TWA was flying continuous day and night mail schedules across the Continent in 24 hours. This was in preparation for passenger flights on the same basis, which followed shortly after.

* * *

In 1935 two New York banking firms, John D. Hertz and Lehman Brothers, bought a controlling interest in TWA. The line was doing well, showing profits both for 1935 and 1936. But losses occurred in the next two years, as a result of heavy purchases of new equipment, including a fleet of new, four-engined Boeing 307 "Stratoliners" and constant-speed airscrews for all aircraft. The banking firms objected, threatened to reorganise the company's management.

In April, 1939, Jack Frye and Paul Richter submitted their case to Howard Hughes, the millionaire, and Hughes bought up a larger interest than that held by Lehman and Hertz. The latter were then forced to sell out, and Hughes has since added to his investments and now holds 46 per cent of TWA's stock.

* * * *

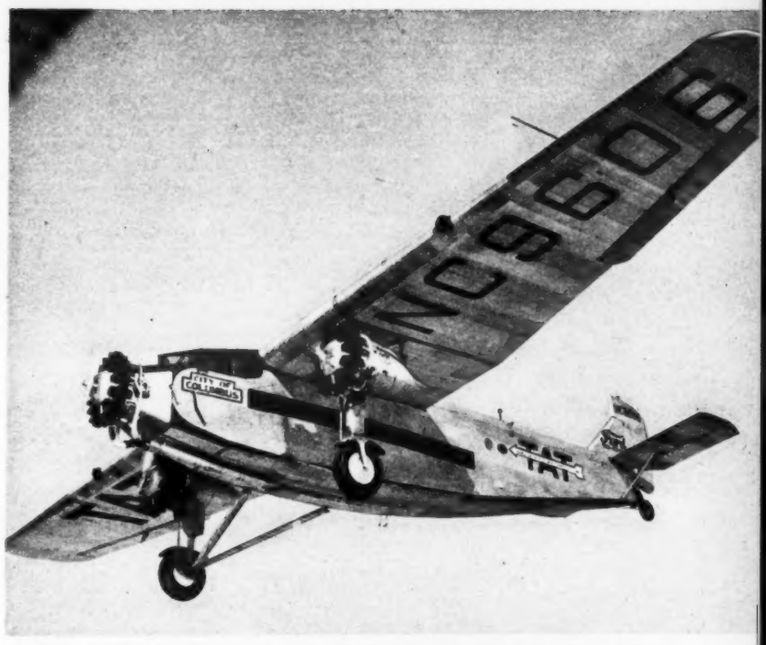
One of TWA's chief characteristics, even more so since Howard Hughes' entry upon the scene, has been its pioneering spirit in the development of new flying equipment. The first trans-Continental services were flown with old Ford "Tin Geese," the well-known, noisy "Tri-motors," and with Fokker aircraft, which were equally slow and noisy and did not offer passengers much comfort.

TWA therefore approached the aircraft manufacturers, and in 1933 the Douglas Aircraft Co. produced the DC-1, which in reality was the prototype of the famous DC-2 and DC-3, and even of the DC-4 and the ultra-modern DC-6. But TWA was not quite satisfied with the DC-1 ; D. W. Tomlinson, the well-known TWA "over-weather" pilot and later Vice-President of Engineering until he entered military service, tested the aircraft for five months. This testing programme resulted in the DC-2, a more refined version, which carried fourteen passengers.

TWA ordered an original fleet of 31 machines and began to operate them in 1934. This step reduced trans-Continental flying time to 16 hours.

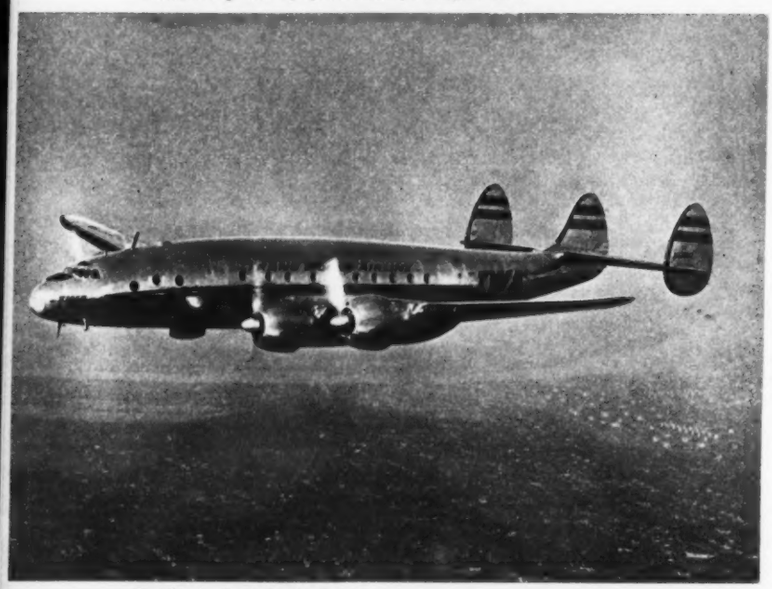
In 1934, Jack Frye became TWA's President, and the ensuing years saw even more intensive experimentation and development of aircraft. It was during this time that Tomlinson explored weather conditions at high altitude, using a Northrop "Gamma" monoplane built by the predecessor of the present Northrop Aircraft, Inc. From this

The new men : (left to right) : *Howard Hughes,* controlling stockholder of TWA. — *Warren Lee Pierson* succeeded General T. B. Wilson as Chairman of the Board of Directors and Managing Director of TWA's International Division. — *LaMotte T. Cohu* has taken over Jack Frye's job as President of TWA. — *Otis F. Bryan,* Vice-President and General Manager of the International Division.



Oldtimers (top to bottom) : *Ford Tri-Motor "Tin Goose"* of Transcontinental Air Transport, one of the predecessors of TWA. — The old *Fokker* monoplane of Jack Frye's first airline, Standard Airlines, Inc. — Fokker 32's were still used for mail and passenger services after TWA's foundation in 1930.

Pioneered by TWA (top to bottom): Douglas DC-3.



Lockheed "Constellation."

exhaustive research came the four-engined Boeing 307 "Stratoliner," the world's first pressurised commercial transport.

TWA's "Stratoliners" were brought into service in 1940, reducing coast-to-coast flying time to 14 hours. Although the same type of aircraft was adopted by Pan American Airways for its international routes, TWA was the first and only domestic airline to place modern four-engined land transports into service at the time.

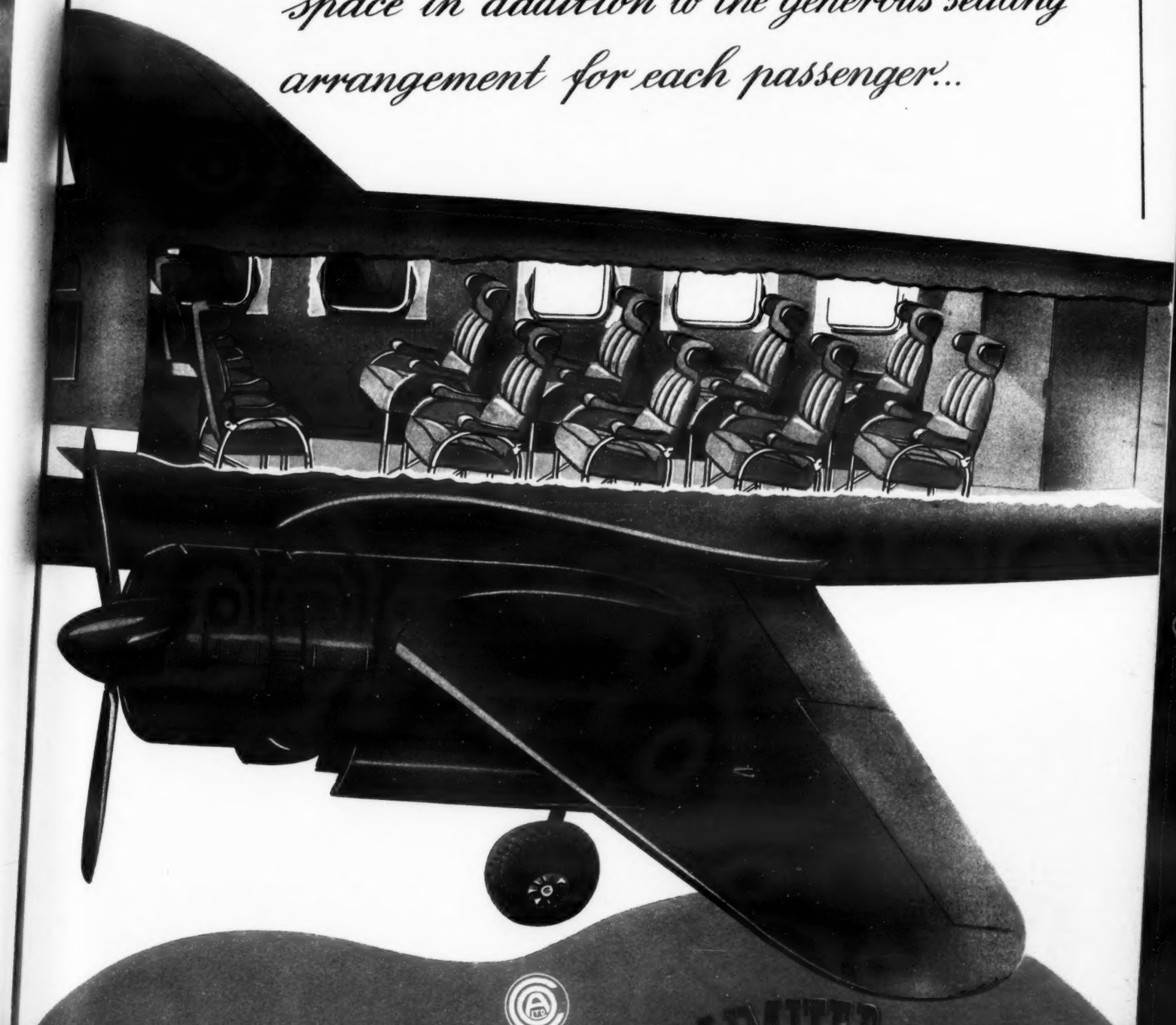
But even before the "Stratoliners" were on the company's commercial routes, TWA was seeking another, more powerful, larger and faster aircraft. Jack Frye and Howard Hughes, now TWA's controlling stockholder, envisaged an aircraft that would fly across oceans at speeds of 300 m.p.h. Their ambition, following Howard Hughes' famous round-the-world flight in 1938, was to build up an airline extending not only from coast-to-coast, but around the world. Hughes and Frye approached the Lockheed Aircraft Corporation in 1939 and submitted the specifications which developed into the "Constellation." Delivery was interrupted by the war when Lockheed turned all its efforts to producing military aircraft. But work progressed on the type, and the first test flight was made in January, 1943.

* * *

When war appeared inevitable, TWA decided to play its rôle in the national defence programme. It was the first airline to make its services available to the Government when, even before Pearl Harbour,

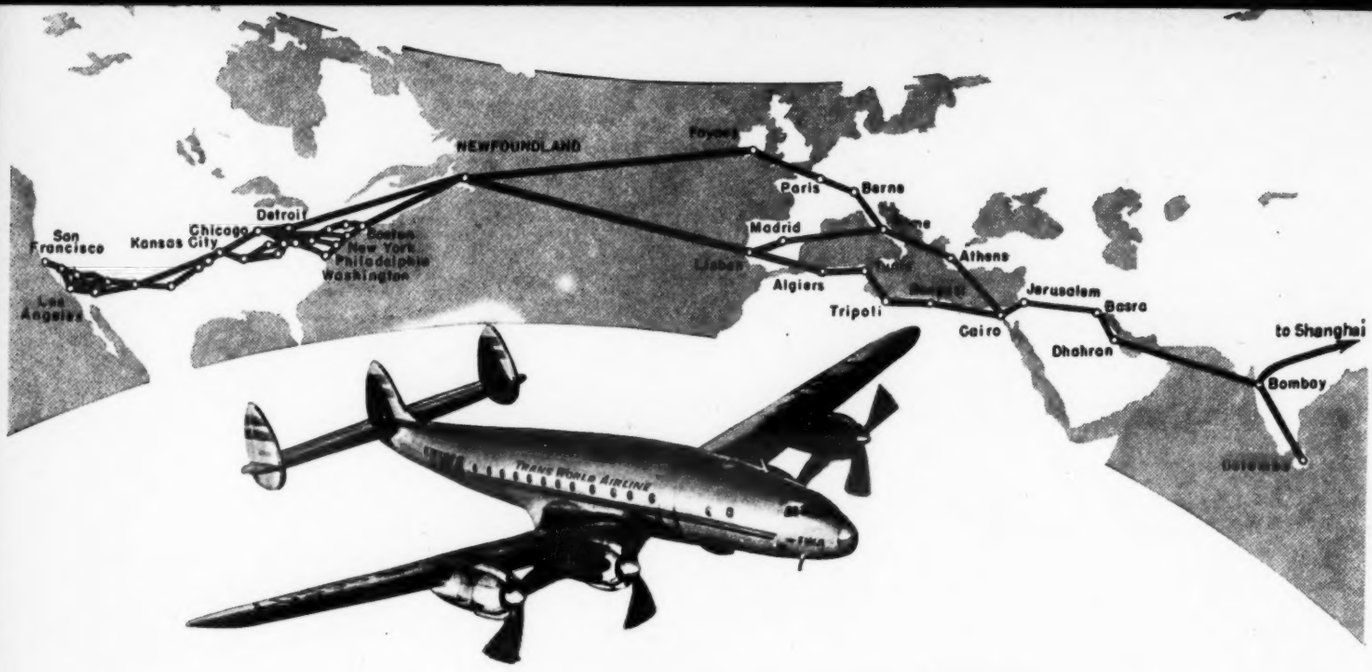
Boeing 307 "Stratoliner."

CONCORDIA *The standard ten seat version has a crew of two and ample luggage space in addition to the generous seating arrangement for each passenger...*



CUNLIFFE-OWEN AIRCRAFT LIMITED

THE AIRPORT, SOUTHAMPTON. ENGLAND.



Jack Frye offered TWA's entire engineering and operating resources to the armed forces. It turned over its fleet of "Stratoliners" to the Army and was the first domestic airline to operate landplane transports overseas for the Army's Air Transport Command. This was on February 26th, 1942, when it despatched one of the Boeing "Stratoliners" from Bolling Field, Washington, to North Africa with vital men and materials. From then until the arrangement was terminated in April, 1946, TWA operated 9,500 overseas contract flights for the A. T. C., carrying more than 15,000,000 lbs. of cargo and over 13,000,000 lbs. of mail in a total of 237,920 flying hours and over 41,782,730 aircraft miles. Other contributions to the war effort included the operation of a four-engine transition training school at Albuquerque, and a vast aircraft modification centre and specialist training programme at its home-base at Kansas City.

* * *

Meanwhile, plans for operating an international network progressed to the point of reality. In the "Constellation" the company had a suitable aircraft, and the next step was to secure a route. Exhaustive economic and technical research preceded the company's application to C. A. B. for a route around the world. On July 5th, 1945, the long-cherished dream was partially realised when the Civil Aeronautics Board awarded TWA a certificate for regular services from the terminal points of Chicago, Detroit, Washington, Philadelphia, New York and Boston across the North Atlantic, via Newfoundland, to Ireland, France, Switzerland, Italy, Greece, North Africa, the Middle East, India and Ceylon. Statistically, CAB's route certificate to India added more than 17,000 miles to TWA's domestic network of 7,700 miles. To take care of its overseas routes, the company's International Division was formed in New York at the end of 1945. From one of America's largest airlines, TWA had grown to be one of the world's biggest air systems.

An initial order for a fleet of "Constellations" costing $ 30,000,000 was placed by TWA on September 14th, 1945. Delivery began with a record-breaking U. S. trans-Continental flight by Jack Frye and Howard Hughes, from Burbank, California, to New York. On February 5th, 1946, a regular service between New York and Paris

"Overweather" Pioneer : Captain "Tommy" Tomlinson of TWA was the outstanding research pilot investigating high-altitude flying conditions.— The aircraft is a Northrop "Gamma".

was instituted, and less than a year later, Trans World Airline, as it is now known, operated eleven round trips weekly across the Atlantic, some of the flights extending as far as Bombay, India.

On August 1st, 1946, the CAB issued an order extending TWA's international routes from their former terminus at Bombay to Shanghai by way of Burma and Indo-China, giving the company a system now 28,000 miles long.

* * *

The picture of TWA's steady growth during the past ten years can be found in its operating figures for that period. In 1937, the airline had a total of 36 aircraft and carried 90,745 passengers. In 1946, with 112 aircraft, TWA carried 917,871 passengers. Total operating revenues in 1937 were $ 5,434,000, and ten years later, in 1946, they amounted to about $ 57,361,000. Early in 1947, the International and Transcontinental Divisions of the airline were producing revenues at the rate of $ 5,000,000 a month.

The record revenue figure for 1946 was achieved despite the withdrawal of the "Constellation" from service for three months to make engineering changes, and a 24-day period of idleness because of the pilot strike.

However, these difficulties, along with the expense of developing the international routes, radically affected TWA's financial resources. Whilst operating revenues reached a record total of $ 57,360,993, operating expenses amounted to $ 72,280,496, which resulted in an operating loss of $ 14,919,503 and a net loss of $ 14,347,836—a very large amount for any airline.

In order to tide the company over its financial troubles, Howard Hughes agreed to advance a loan of $ 10,000,000 to TWA. However, this amount could never satisfy the airline's requirements, as TWA is still in the middle of an important expansion programme. What it wanted was at least another $ 40,000,000 to provide working capital and finance its expansion.

The money could be raised by either one of two methods : the first would have been to increase the company's stock ; Jack Frye was in favour of such a measure, but Howard Hughes objected, because this would have reduced the percentage of his holding in the company. The second solution was to obtain bank loans ; however, the banks were not very keen on lending money to a line whose future did not seem quite certain to the mind of a banker, and Jack Frye thereupon turned for help to the U. S. Government-controlled Reconstruction Finance Corporation. In the eyes of Howard Hughes, an individualist of the first order and a staunch believer in private enterprise, this would have meant handing control of the line to the Government, and he opposed the move.

Training to make passengers comfortable : Air hostesses at TWA's special school at Wilmington, Del. — *"On parle français..."*

The final result was that last February Jack Frye, President and creator of TWA and formerly Hughes' close personal friend, left the company together with Paul E. Richter, his long-time aide, who had meanwhile risen to the post of Senior Vice-President, and several other top executives. Howard Hughes, working through his representatives within TWA, then proceeded to reorganise the company, introducing measures of economy, slashing regional managements wherever these were considered "top-heavy." He also undertook to raise the $ 40,000,000 the company wanted from private sources, and at the same time opposed suggestions calling for the merger of TWA with the powerful Pan American Airways. He saw no need for such a move, as he believed that TWA's International and Continental Divisions will be able to show a profit within two months from May 1st. Hughes, a shrewd businessman, may be right in his forecast : during January, 1947 (the last month in which the Frye management was responsible), TWA lost less money than either American Airlines or United Air Lines, its main trans-Continental competitors.

TWA's new President, elected on April 24th, 1947, is *LaMotte T. Cohu*, Chairman of the Board and General Manager of Northrop Aircraft, Inc., for many years a leading figure in American aviation management and long-time member of TWA's Board of Directors ; Cohu, a World War I Navy pilot, aviation financier, and one-time President of American Airlines, has severed his affiliations with Northrop and will concentrate on the management of the airline. At the same time, *Warren Lee Pierson*, President of American Cable and Radio Corp., and former President of the Government's Export-Import Bank, was elected Chairman of the Board and Managing Director of the International Division.

Hughes again showed his business sense in the reorganisation : old-timers such as J. A. Collings were retained as Vice President-Transportation, Otis F. Bryan as Vice President and General Manager of the International Division, E. O. Cocke as Vice President-Traffic, J. C. Franklin as Vice President-Engineering.

* * *

What of TWA's future ? In its 1946 annual report to stockholders the management stated with subdued optimism : " ... Despite the heavy loss incurred during the year 1946, it is possible to look forward with much hope to the future."

Traffic statistics for the beginning of 1947 seem to justify this optimism, both for the international and domestic services : at home, full bookings for weeks ahead were reported on the trans-Continental service, and TWA re-ordered four of the "Constellation" contract it had cancelled earlier this year, to place them in service between New York and Chicago. On the Atlantic route, TWA alone carried a total of 347 passengers on eastbound flights in the first week of April, compared with 134 passengers in the second week of January. TWA estimates that in 1947 it will carry about 25,000 passengers, including 8,000 tourists, from the USA to Europe, the Middle East and India. Considering that the 83,000-ton liner "Queen Elizabeth" accommodates just over 2,000 passengers per voyage, this means that TWA's services are roughly equivalent to one monthly trip by the "Queen." So far as the Europe-U. S. A. return service is concerned, all seats are booked for months ahead.

Meanwhile, TWA is adding new services to its already very impressive international timetables of eleven weekly round trips on the Atlantic.

And in the very near future TWA hopes to fulfil its ambition of inaugurating—jointly with Northwest Airlines — the fastest regular commercial round-the-world air service, by opening the last leg of its share of the route, namely, the segment from Bombay to Mandalay (Burma), Hanoi (Indo-China), Canton and Shanghai.

It is not known whether under its new management TWA plans to put into effect the project which Jack Frye, TWA's creator, had envisaged : a $ 2,500 one-month *de luxe* around-the-world cruise, including three days in the air, the balance for sight-seeing. But TWA has at least got over its most serious troubles : it is flying again—and growing.

P. A. B.

We Ought To Make Them Work

The caveman again dropped the oblong piece of metal he had just found. He did not know what to do with it. It rang as it fell, but it did not break, as stones are apt to do. It was cold to the touch and it gleamed where it hit the ground. The caveman picked it up again and put it away, in a safe place in his cave. But he still did not know what to do with it. Two weeks later he quarrelled with his neighbour. Their quarrel grew more bitter. The caveman retrieved the piece of metal from its hiding-place and threw it at his neighbour, hitting him on the head. The neighbour fell down, dead ; and, from that moment onwards, the caveman knew what metal was good for. Perhaps he was also mistaken. But this thought did not occur to him.

It is now 1947, and it has not yet occurred to us. When a neighbour dies we usually say, regretfully : "You see, science is to blame." But science killed our neighbour only because we did not know how to make it work properly. Science must be kept occupied. Or else, like humans, it will err.

I fear that aircraft are not being given sufficient work. This thought is suggested by the experiments in nuclear fission.

Happily, we are doing something today about finding work for aircraft ; above all in commercial air transportation However, it still does not seem to be sufficient. In my opinion, there are still too many aircraft which cannot find jobs and consequently join the army. We ought to make them work, until they gasp for breath.

Up to the present it is the helicopter, the messenger-boy of the air, which is best being taken care of. The young helicopter is a jack-of-all-trades, with plenty of jobs open to him. He can be a perfect ambulance attendant, in which capacity he is capable of virtually fetching patients from their own bedsides. On Sundays, he takes the city couple for an outing. And if he sees a man at the seaside, struggling against the waves, he thinks nothing of plunging to the rescue and fishing the victim out. He is a very useful fellow.

But nowadays, even the most ordinary races of the aerodyne kingdom are called on to do more than serve as mere airborne stage-coaches for transcontinental travellers. Switzerland recently delivered 100,000 trout eggs by air to a piscicultural establishment in Bogota. Thanks to the speed with which they were transported, the eggs finished up, without suspicious odour, in the fish ponds of Colombia ; and they will turn into Swiss trout which will have leaped more than 7,000 miles before they were born. And as we are on the subject of eggs : the United States Rubber Co. has developed a rubber sack for parachuting air mail, and guarantees safe delivery of the most fragile commodities ; tests carried out with eggs and chinaware went off without a hitch. Meanwhile, we have no desire to spoil U. S. Rubber's business line, but whoever wants a tea-service that quickly—even if it were a question of getting married in three days' time ?

It often occurs that racehorses are in a hurry. Towards the end of last year, American Overseas Airlines set a precedent by embarking six Irish champions at Shannon. They were flown to California in 29 hours, without any mishaps ; and during the trip they had a chance to admire this competitive means of transport and to take an example from its speed. As our photographs show, the stable was perfect in every respect and, on leaving the aircraft, the noble animals were so airminded that the famous Irish Association of "Bloodstock Breeders and Horse Owners" has since decided to conduct all future deliveries of horses abroad by air.

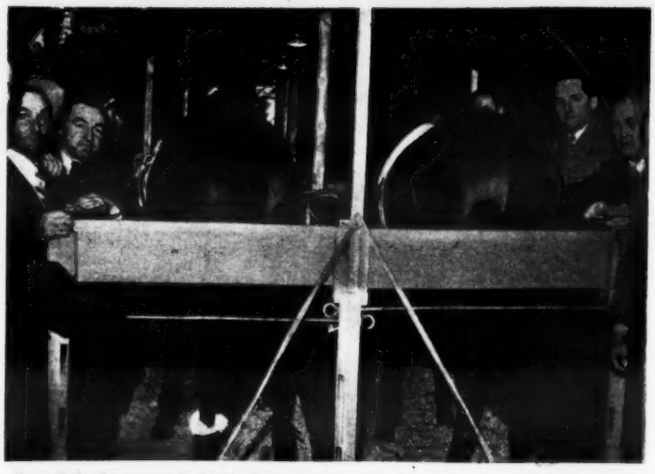
What goes for racehorses goes for racing-cars too. The Don Lee, Inc., which bought a Mercedes-Benz in Europe in order to enter it in the Indianapolis Memorial Day Race, had it freighted to California by Californian Eastern Airways.

Footballers, in contrast, do not seem to be so keen on aeroplanes lending a helping hand. When the English Football Association recently suggested chartering a plane for carrying the national team to Zurich and Lisbon, English soccer circles frowned as they voiced their disapproval of this new-fangled idea. They reminded the Association that it had so far always been opposed to air transportation of football teams ; Plymouth Argyle, who invariably have to travel long distances to their matches, had been given a negative answer to their request some time ago for permission to go by air. Well, there might be a certain amount of common sense behind this aversion to aeroplanes nosing into ball games. The sportsman's maxim is, after

The quadruped air passengers waiting to embark on American Overseas Airlines' special transport, the "Missouri."

One of the horses being taken aboard.

The special gangway for getting the horses in to the plane.



Two of the horses ready for the journey.

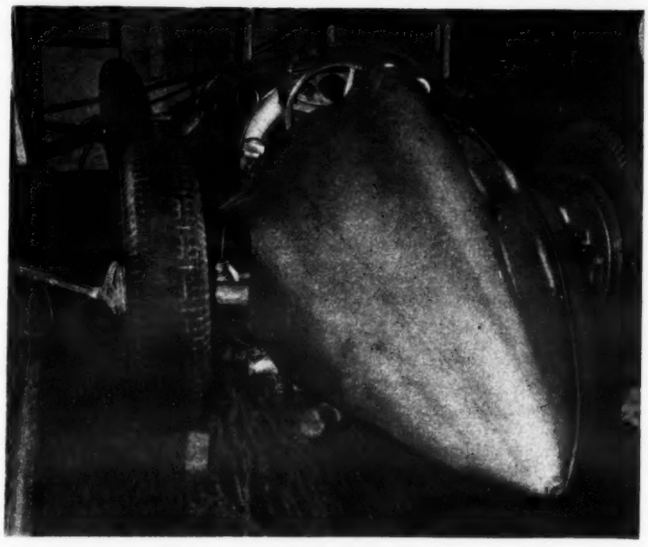
all, to keep the ball low and within prescribed limits. Goodness knows what nefarious influence aeroplanes might not have, with their soaring tendencies and their scorn of boundaries.

But it would seem that the aeroplane is not so easily discouraged. There are other sports which do not tie their participants down to such rigidly confined spaces ; skiing, for instance. The Byrd expedition required twelve long-range transport aircraft as well as thirteen ships. The heavier aeroplane showed that it, too, was perfectly capable of effecting a take-off from an aircraft carrier and, furthermore, with skis fitted to its undercarriage, of landing on snow and ice.

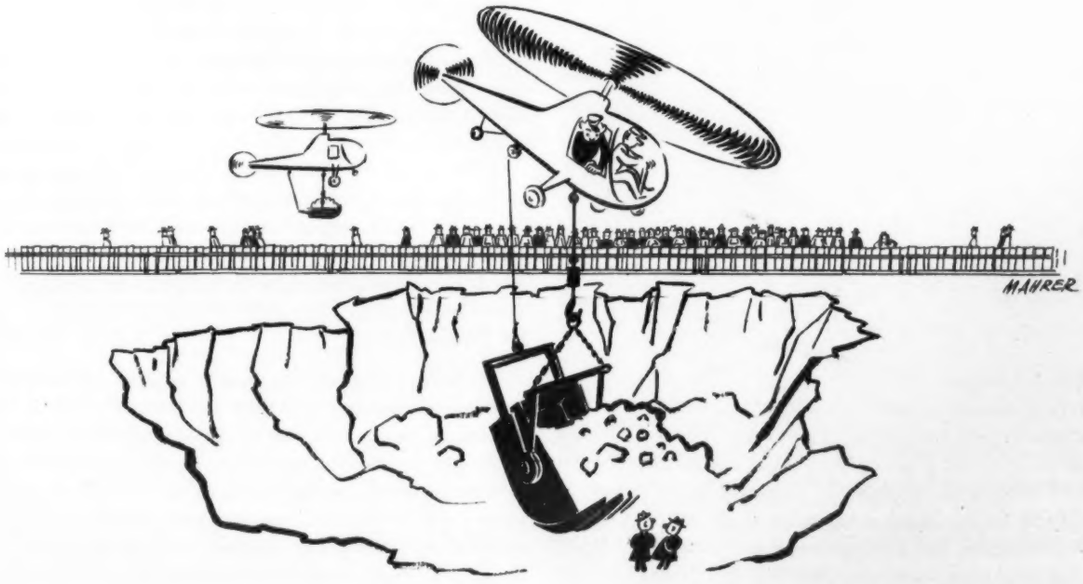
However, when UNRRA announced its fears of an epidemic of smallpox breaking out in Italy and Yugoslavia, a four-engined "Mainliner" of United Air Lines lost no time in rushing to the rescue with over half-a-million phials of serum. The aeroplane can be a life-saver, too.

Aircraft must not go to war. If it is excitement they are looking for, they ought to go in for home politics. Strikers at an electricity plant in New Bedford were recently provisioned by a helicopter ; and the latest Danish parliamentary elections, which are only valid if all the electoral districts have voted, were saved by an aeroplane bringing the voting papers to the icebound island of Läsö.

We ought to make them work. EH



A Mercedes Benz had to be rushed from Europe to the U. S. A. for the Indianapolis Memorial Day Race.



The End of the American Airline Crisis

Watching the Thermometer.

It is not hard to understand that the Americans were inclined to take the temperature of their airline business minute by minute. The stock market had trained them to expect it to be at boiling point one day, and at freezing point the next. The U. S. airlines experienced a crisis in 1946 ; not a fatal one, but nevertheless serious enough. They are having to recover from it, and one is apt to grow impatient while convalescing.

Just how serious this crisis was, can be discerned from the fact that only eight of the domestic carriers could show profits for 1946. These eight included only two of the "big five," and the profits were nothing to sing about. The losses incurred by the remaining concerns were heavy.

And scarcely have the first rays of sunshine had time to pierce the gloom than the foundations of all former diagnoses and prognoses have been torn up.

Those same experts who, the day before yesterday, were prophesying a rosy future, and yesterday an early grave, are now in raptures again about the future of the airline business.

The Truisms.

Among this chorus of hysterical prophets, it is soothing to find at least some voices which are neither triumphant nor complaining, but sober and just because of that, optimistic ; and which take the trouble to examine the long-term possibilities in U. S. civil aviation, and in civil aviation as whole. In his lecture on January 10th at McGill University, Dr. Edward P. Warner, then President of PICAO, looked forward to a progressive development of air transportation. But he was thinking more than just one week ahead.

First of all he emphasised that every serious examination of the matter must necessarily be based on the long-known but repeatedly forgotten fundaments of all air transportation :

> "Characteristically it has a high degree of independence of the conditions of the underlying terrain ; it is enormously speedy ; it is not inherently very economical, as compared with other forms of transport operating under conditions favourable to themselves ; it is highly flexible in its ability to accommodate itself to the demands of its patronage, both as to routing and as to frequency of operation ; it is better suited for transportation over reasonably long distances than over very short."

It would be unwise to cast these statements aside as truisms. It has happened only too often that these apparent "truisms" have been disregarded or glossed over to the detriment of airline analysis and planning.

As regards the airlines' independence of the conditions of the underlying terrain, Warner says :

> "It is a fascinating pastime to stretch strings across the surface of a globe to mark the great circle courses ; and to discover that the shortest route from Montreal to Singapore passes across the centre of Baffin Island, within a few miles of the North Pole, and over the Gobi Desert. But the route between Montreal and Singapore by way of London, Cairo and Calcutta is only about 15 per cent longer, and possesses substantial compensating advantages in other respects."

Truism ? Oh, no ! Many a company has had to find out just how dangerous "stretching strings" could be, and just what losses could be brought about by opening uneconomic routes, or operating routes which exceeded their financial means. To take an example : the development of higher-performance aircraft led to a fierce fight among a number of airline companies for the Denver-Los Angeles route. Finally, Western Air Lines won the last round, against United Air Lines. WAL obtained the Denver-Los Angeles certificate and—offered it for sale to United four weeks later. Western's President admitted that "like a good many other carriers" his company had been "suffering from expansionitis." It was now withdrawing all but one route application for services east of the Rocky Mountains and would concentrate on the Far West.

Let us listen to what Warner has to say about the relative economy of air transportation :

> "The aeroplane is not inherently a highly economical form of transport. The lowest rates at which cargo can now be carried by air under ordinary commercial conditions, taking loads as they come for a scheduled service, are about 25 cents to 30 cents per mile—a reduction of approximately one-half from the minimum figure attainable in 1929. That has to be compared with an average of freight revenue on Canadian railways in 1936-39 of 0.96 cents per ton-mile, and an average cost of carrying bulk freight in ocean vessels of 0.1 cents per ton-mile. The comparison on passenger routes is much more favourable to the aeroplane. If the comparison is made with the pullman service, the airline fares very nearly match those of the railroad ; but even in transporting passengers the aeroplane's costs are substantially higher than those of the railroad or bus for the most economical forms of transportation that surface conveyances have to offer. Relatively high costs of air transportation are not attributable to any one element. They are quite largely attributable to the fact that air transportation is a business in which only the best is good enough."

More often than not we read just the opposite about air transportation. It is a dangerous game to play around with the thought that "air travel is cheaper than surface travel," and thus to build financial castles-in-the-air.

In his speech on the occasion of the dedication of the DC-6 to public service, on March 28th, James M. Landis, the Chairman of the U. S. Civil Aeronautics Board, also drew attention to these thoughts and warned against too hasty mathematical calculations on how many people the aeroplane had lately "won over" from surface transportation.

The Postwar Hell.

By leaving aside all momentarily inspired calculations, which can only lead to false conclusions, we automatically come to the exigencies and development possibilities of the airline business. The yearning is no longer for mass-commodity transportation, but concentration is on selecting those commodities which, by their nature, are more suited to air transport than any other means of conveyance. Landis began his study of the question with a phrase of Abraham Lincoln : "Before we decide what to do, let us find out where we are and where we intend to go." The course of his speech showed what could be developed, what needed to be ameliorated, and how the airlines could finally

extricate themselves from the crisis which, in an interview with United Air Lines' President, W. A. Patterson, "Time" magazine calls "their own postwar hell," stating that "some of the burning was due to their own sins." As "Time" puts it :

"They had sometimes seemed to run their lines, not like globe-straddling enterprisers, but like cow-pasture barnstormers. They had cancelled flights without telling passengers till they appeared at the airport ; they had lost their luggage ; when bad weather closed in, they had set passengers down in out-of-the-way airports and left them to shift for themselves."

On the other hand, the crisis suffered in 1946 by the U. S. airlines was not entirely due to their own fault. Nobody could expect the conversion from war to peace conditions to proceed without sacrifices. It is a fact that the stressed financial position of the various airlines is in the majority of cases attributable to expenditure on new flying equipment. But crises are intensified by bad strategy. And nothing causes bad strategy more than the disregard of sound fundamental principles.

Atlantic Backchat.

Concentrating one's forces at the wrong spot results in a weakening of the line. At present, there seems to be a good deal of energy being wasted in reciprocal wise-cracking about trans-Atlantic competition.

Articles in the American press began to say that European competition on the Atlantic amounted to a "negligible quantity."

On March 26th, the U. S. Civil Aeronautics Board published a survey of the operations of all airlines flying the Atlantic, and declared that 84 per cent of all trans-Atlantic flights in 1946 had been carried out be U. S. carriers, who had also transported 86 per cent of all the passengers. The CAB statistics are as follows :

American Carriers.	*Flights*	*Passengers*
Pan American Airways	1,100	33,635
American Overseas Airlines	1,059	29,115
Trans World Airline	830	24,727
European Carriers.		
KLM Royal Dutch Airlines	189	6,399
Air France	172	5,114
Scandinavian Airlines System	113	2,149
Sabena (Belgium)	12	317

The CAB's President, Landis, supplemented these statistics with the following words :

"We were competing almost equally with the foreigner and we were licking him hands over fists when it came to dealing with our own citizens... We can compete with the foreigner, not only compete with him, but it looks as if he can't compete too well with us. And, why ? Primarily because of our technical capacity. We build better ships. The foreigner gets to buy them, but we fly them better than he does..."

Naturally enough, this was so loud that it could not help being heard on the other side of the Atlantic. British Overseas Airways Corporation and the Belgian Sabena stood up on their hind legs and refuted CAB's statistics. Scandinavian Airlines System, the joint organisation of Nordic carriers, answered with the following figures for the second half of 1946 :

American Carriers.	*Flights*	*Passengers*
American Overseas Airlines	688	20,073
Pan American Airways	580	18,407
Trans World Airline	440	13,126
European Carriers.		
Air France	157	5,104
KLM Royal Dutch Airlines	141	4,755
British Overseas Airways Corp.	183	3,191
Scandinavian Airlines System	104	2,147
Sabena	12	386

This brought down the American attribution for the second half of 1946, from 86 to 76.7 per cent. And nothing seems to have altered much for the first four months of this year. Meanwhile, an unofficial U. S. list of statistics for eastbound Atlantic operations attributes about 75 per cent to the three major U. S. carriers on this route ; KLM Royal Dutch airlines, however, ranking second among European carriers for 1946, has somehow or other been "forgotten."

American Carriers	*Flights*	*Passengers*
Trans World Airline	151	3,010
Pan American Airways	166	1,798
American Overseas Airlines	189	1,508
European Carriers		
British Overseas Airways Corp.	52	688
Air France	36	665
Scandinavian Airlines System.	61	600

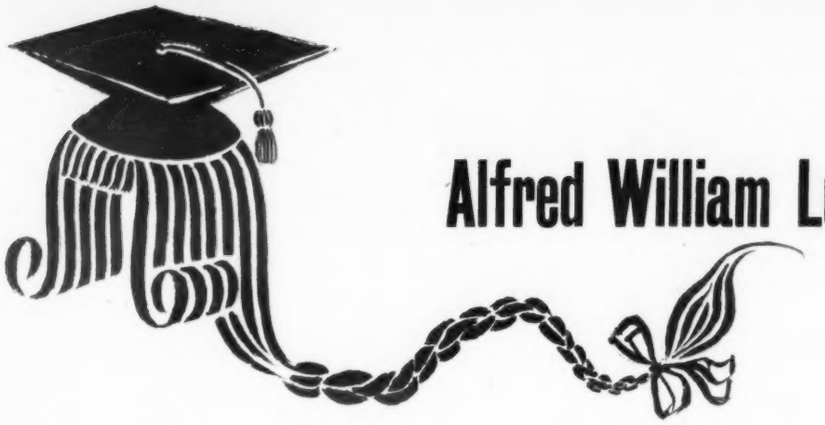
And thus the wise-cracking continued back and forth over the Atlantic. Meanwhile, however, the Americans have lost a little of their earlier optimism, stating now that "foreign competition is increasing much faster than anticipated."

All the same, 75 per cent of all Atlantic traffic is a great deal, and despite the loss of 10 per cent, a considerable performance. American airline companies can be even happier about it, now that the trans-Atlantic traffic has fortunately become denser again. And the prospects for world aviation altogether are not bad.

Warner believes that the end of 1951 will see the introduction of turbine-propelled aircraft into commercial aviation, and that during the next five years, great progress will be made in the development, installation and practical use of radio aids to navigation and landing, putting us on the brink of substantial elimination of cancellations, delays, and diversions due to low visibility. His own words are : "I believe that the 1951 traffic on the world's airlines will be a little more than double that of 1946..."

So why worry ? EH

The leading men in American and European civil aviation working peacefully together : IATA Executive Committee, at present meeting in Montreal.
Seated from left to right : Dr. Alfred Plesman, President of KLM Royal Dutch Airlines ; Sir William P. Hildred, Director-General of IATA ; Harold M. Bixby, Vice-President of Pan American Airways.
Standing : John E. Slater, Chairman of American Overseas Airlines ; Dr. Paulo Sampaio, President of Panair do Brasil ; J. Ronald McCrindle, Deputy Director-General of British Overseas Airways Corp. ; A. F. T. Cambridge, Director-General of Indian National Airways ; René Briend, Managing-Director of Air France.



Alfred William Ludditt Has No Claim

Prior to boarding the aircraft of Ginger Coote Airways Ltd. Alfred William Ludditt and his companion-appellants each signed a ticket containing the following provision :

"In consideration of the Ginger Coote Airways Ltd. of Vancouver, B. C., permitting me, at my own risk against all casualties to fly as a passenger in any aircraft owned or operated by the said Ginger Coote Airways Ltd., I hereby agree... that such flight... shall be at my own risk, against all casualties to myself or my property and that I take all risk of every kind, no matter how caused, and I hereby release and discharge the Ginger Coote Airways Ltd. and indemnify it of and from all actions, claims and demands of every nature and kind whatsoever, which I, or my heirs, executors, administrators or assigns may now or may or can at any time hereafter, have against the Ginger Coote Airways Ltd., for or on account of any loss, damage or injury to me, my person or property while so flying, and whether in or on any such aircraft or getting to or from, into or off, or in or out thereof ; or in any manner in connection with or in consequence of such flight, and whether any such loss, damage or injury be caused by negligence, default, or misconduct of the Ginger Coote Airways Ltd. itself, servants, agents or members, or otherwise howsoever."

The air trip from Vancouver to Zeballos on Vancouver Island, Canada, would have required less than 30 minutes. But the aeroplane required less than that to catch fire. Wearily convalescing in hospital, Alfred William Ludditt and his two companions-in-misfortune had plenty of time to regret having signed their names to such a provision. But their righteous indignation got the better of them : notwithstanding this infamous provision, they sued the carrier. And now they had even more time to think it over : the case lasted six years, during which it went through three Courts, going from British Columbia to London. On February 5th, 1947, the Lords of the Judicial Committee of the Privy Council, the supreme authority in all British litigation, stated that the appeal (lodged in 1941) in their judgement failed and should be dismissed.

"Well, it was to be expected from the start," says anybody who is not acquainted with the snares in legislation and jurisdiction, and can therefore not size up what their Lordships in London did in particular when they declared that a contract was a contract, and that a renunciation was a renunciation.

During the early years of aviation, such renunciation provisions were not exceptional. They were the rule, signed prior to every trip by air. On May 31st, 1924, a French law was drafted, which permitted them with certain restrictions. As this mode of transport progressed, legislators slowly but surely arrived at the opinion that a general application of such a provision was unjust. The Warsaw Convention, which governs the liability of the airline operator, makes it quite clear in article 23 that any contract which precludes the liability of the airline operator is not valid.

And the only way in which the operator can be exonerated from his liability is by proving, in accordance with article 20 of the Warsaw Convention, that he had chosen his personnel carefully and that every possible measure had been taken to prevent accidents which one could be expected to foresee. Courts are very difficult to satisfy on this count, and Ginger Coote Airways would in all likelihood have had to pay damages if they had been on an inter-state flight.

What did the English judges do ? International law could not be applied. The Privy Council based its verdict on the Railway and Canal Traffic Act of 1845 and the (Dominion) Transport Act of 1938. To decide on the liability of a common carrier, it reverted to a decision of the Exchequer Chamber in 1860, which concerned a railway company and cited such expressions as "Acts of God" and impediments by "Enemies of the King."

And their Lordships, who did not examine the problem from a material point of view, but purely as a legal matter, examined it very thoroughly. They went into the question of whether a carrier of goods is subject to heavier liabilities than a carrier of passengers ; a common carrier to heavier liabilities than a private carrier : to what category did the carrier in question belong and were its provisions and tariffs at all legal ? Their Lordships considered everything. One point only was not discussed : was Alfred William Ludditt's signature legally binding in this instance ?

Of "common decency" or "good faith" conceptions, which Continental courts would certainly have applied against Ludditt's signature, there is no mention in the text of the Privy Council's verdict. The judgement was delivered in the following laconic terms :

"If a passenger has entered a train on a mere invitation or permission from a railway company without more, and he received injury in an accident caused by the negligence of its servants, the company is liable for damages for breach of a general duty to exercise care. Such a breach can be regarded as one either of an implied contract, or of a duty imposed by the general law, and in the latter case as in form a tort. But in either view this general duty may, subject to such statutory restrictions as exist in Canada and in England in different ways, be superseded by a specific contract, which may either enlarge, diminish, or exclude it. If the law authorises it, such a contract cannot be pronounced to be unreasonable by a Court of justice. The specific contract, with its incidents either expressed or attached by law, becomes in such a case the only measure of the duties between the parties, and the plaintiff cannot by any device or form get more than the contract allows him."

Vigilanti jura sunt scripta, was the way in which the Romans looked at it, who set little store by social legislation to "protect fools against their own foolishness" ; and *pacta sunt servanda*—contracts are there to be adhered to.

The English judges said the same. One might think them inexorable. Perhaps ; but just, all the same. Here on the Continent we have fallen into the habit of looking upon a judge as a man who is there to give a convenient meaning to our declarations. As a rule, airline passengers belong to a class of society which one could hardly qualify as ignorant in business affairs, and which does not need Society to protect it against its own follies.

Luckily for the public nowadays, the majority of carriers would not dream of binding their passengers to such provisions. But it is for the public to use its head and to choose the right carrier.

EH

The Development of the V2

By S. F. Erdmann, B.Sc., Amsterdam *

The rocket projectile has, for some time already, intrigued authors of futuristic novels, adventurous idealists and scientific optimists, the aim being to travel into space and, once liberated from the earth's gravitation, to attain the neighbouring celestial bodies. The chief problems, in their minds, were those of propellant power, efficiency, the requirements with regard to mass and energy, the size of the rocket and the form of the most favourable path of flight. Consideration was given even to the possibility of gradually overcoming the earth's force of gravity by anchoring fuelling islands in space, which would gravitate like satellite planets at short distances around the earth. But it is astonishing how little attention was paid to the fact that, for take-offs and landings, it is above all the atmosphere which must be overcome. It was precisely here where people failed to grasp the enormity of the problem.

No experience whatsoever had been gathered and there existed no scientific data concerning the behaviour of the air with respect to speeds between 1,000 and 3,000 m/sec., such as already formed the basis of all these projects within the atmosphere. Then, there was no adequate possibility of filling this decisive gap and acquiring the necessary data. Any tests in this direction would, again, have set, as primary requirement, the existence already of those very projectiles which it was intended to develop. A number of far too optimistic experiments turn out to be absolutely fruitless, and contributed nothing of any value to the required knowledge.

This was about how matters stood in Germany when the military authorities, all the same setting a simpler goal, expressed their desire for rocket projectiles. The initial requirement was not to travel through the universal space, but to attain earthbound targets at about 300 to 400 kilometres distance ; later, this distance was to be tenfold. This concerned Project A 4 (V 2), which, as we now know, involved speeds more than five times that of sound. In view of the restricted data available at the time, all hopes were based on the newly-born and still little tested principle of the supersonic wind tunnel ; and what was at that time the biggest wind-tunnel plant of its kind was erected at Peenemünde.

To begin with, the mathematicians demanded the drag, lift and stability values relative to the entire range of flight for calculating the flight path. Three-component and oscillation measurements led to the development of the fuselage and tail assembly, and yielded the desired results. In this connection, it had to be found out whether the values measured from the scale model (25-30 cm. in length) could be transferred quantitatively to the full-size original version (14 m in length) with a linear enlargement of 1 : 50. It was also possible to give the projectile's surface temperature range with respect to the entire flight path.

In order to relieve the jet tabs, it was found necessary to incorporate Flettner flaps for eliminating the twist. The next consideration was, therefore, to gain an approximate idea, as regards effective functioning, static loading and trimming moment, of what was to be the first supersonic-speed Flettner flap in the history of aerodynamics. New measuring methods had to be developed in order to check the calculations in the wind tunnel and supply exact values. The supersonic wind tunnel fulfilled this purpose.

Meanwhile, however, a new, experimentally intricate problem soon arose. For strength calculations on the equipment, the statisticians demanded a precise plan of the distribution of the air forces reacting on the projectile and its control surfaces for the entire flight path. This demand was of fundamental importance as regards continuation of the project, because, for reasons of weight economy, it was intended to incorporate a light monocoque construction with steel sheeting of only 0.5 mm thickness as covering, which had to withstand impacts up to 45,000 kg/m². The distribution of the air forces could only be ascertained by means of pressure measurements. Thereby, it was not even known how quantitative pressure measurements could at all be effected at supersonic speeds. Here was another instance where, after one and a half years of systematic preliminary investigations, possibilities and new methods were found, which fulfilled all requirements unexpectedly well. As may be seen, the development work proper was constantly accompanied by a comprehensive basic research programme.

As regards the propulsive jet, it was believed at first that all the necessary data could be derived solely from combustion trials on the test bench. Doubts arose only at the last moment prior to the initial trial flight of the full-size model. Again it was a case of the supersonic wind tunnel's having to come to the assistance. The anticipated jet stream radiation, the hinge-moment characteristics of the jet tabs, the influence of the jet stream on drag, and other aerodynamic data, had to be examined in relation to flight altitude and speed ; and all concerned were astonished to find that these relations bore heavily on the issue. Had these examinations not been conducted, the result could very well have been a last-minute catastrophe. It was only now that the apparatus was ready from the aerodynamic point of view for testing in independent, automatically-piloted flight.

The flight path and speed range were measured by means of cinematographic theodolites, Wohlmann transmitters (electrical Doppler principle) and Würzburg equipment (radar principle). The annealing colours of the outer surfaces of fallen equipment and measurements taken by means of fusible contacts gave indications of the temperatures which actually occurred. The transmitting equipment connected to twelve measuring points, each with a definite function, yielded complementary information on actual conditions during the flight. Consequent upon the results thus obtained, numerous modifications and ameliorations had to be made in connection with the power plant, statics, and electrical control. The measurements effected in the supersonic wind tunnel were almost entirely confirmed.

Thus, the A 4 (V 2) equipment provided the first means of propelling a robot aerial missile from a stationary position through the sonic barrier into the supersonic region, all the time maintaining a continual acceleration. All the aerodynamics work, including

* S. F. Erdmann, at present on the engineering staff of the Dutch aeronautical laboratory in Amsterdam, is one of the relatively small circle of leading scientists who worked on the development of the German V2 in Peenemünde. The author wishes to emphasise that his writings are entirely from memory, and that the graphs in this article are therefore qualitatively correct, though quantitatively not altogether definite.

the propulsive jet and development of the jet tabs, was wholly accomplished in the wind tunnel—thus, in the laboratory with a scale model—and revealed no discrepancies when it came to actual flight testing. With this, the way was also found how to conduct such developments under financially bearable conditions.

Development History.

In the field of rocket-projectile development, the V 2 represents the beginning of a new epoch in the technics of transportation. Its history is in lively contrast to the procedure purely guided by scientific standpoints, with which aerodynamics acquired its most valuable asset, the wind tunnel, and which yielded new ways and means to free the science of ballistics from its deadlock.

The origin of this development, and simultaneously the embryon of its realisation, may be attributed to two students. The one, imbued with fantastic ideas of forthcoming space ships, was prepared, like so many of his predecessors, to devote himself to this task, notwithstanding the fact that practically none of the necessary knowledge was available at the time. The other, a young officer, was deeply impressed by these aims and conceptions, but more reserved in his belief of their possible realisation. He recognised the immense military import of large-size rockets, the future possibilities they incurred, and simultaneously saw therein the means of providing the missing basic scientific data which would ultimately lead to the space ship. The chief requirements coincided because, for both the space ship and the long-distance artillery missile, not only the spanning of great distances at high speeds is decisive, but also a maximum of accuracy as regards the flight path.

Thus evolved the plan to develop rockets which were to take off from a vertical position with low acceleration, be guided as soon as possible into the desired direction of flight, and be controlled during the entire duration of the propulsive action. Fully automatic robot-control was foreseen, the governing part of which was to be a steering mechanism working to a flight path programme which was determined in function of time. This mechanism comprised a plane stabilised by two gyroscopes. The executive organs were to be the jet tabs. An eventual deviation from the given course was to be balanced by a correcting counteraction of the jet tabs, though this could be dispensed with in the case of a radio breakdown. The final speed, and thus the firing range, were determined by the moment at which the jet stream was to be cut out. In the interest of accurate aiming, eventual power plant vacillations were not ascertained on a time principle, but continuously and automatically indicated by a special integration device. By integrating the acceleration over the time, the cease-power control was started as soon as a pre-determined value as reached.

Starting along these lines, the whole development programme comprised four phases, whereby it is not certain whether the two last phases were foreseen from the start, or only added later :

(1) Speed, 1,500 m/sec. ; range, 300 km ;

(2) Speed, 3,500 m/sec. ; range, 4,000 km ;

(3) Speed, 7,000 m/sec. ; sufficient for a fuelling island meant to gravitate like the moon around the earth outside the atmosphere ;

(4) The space ship for taking off from a fuelling island.

Initially, in order not to meet with a definite refusal by the conservative military authorities to sanction the project, only the first phase was revealed to start with, and the second phase a little later. The first phase denotes the development of the V 2, described in more detail in the paragraphs below. It received the following final formulation, or task specification :

(1) At a firing range of 300 km, a mean dissemination of 600×600 m should not be exceeded.

(2) The war load should weigh 1 ton. Its radius of effect corresponding to the above area would make spot target combat possible.

(3) A fully automatic control should allow for the flight path to be maintained in face of any undesirable influence.

(4) The high speed of flight, much greater than that of the fastest missile hitherto built, should make all warning and defence impossible.

(5) A small amount of ground equipment and complete motorisation should allow for re-positioning within a few hours.

As regards its qualities as a defensive weapon, these specifications entailed nothing new. It only means an increase in performance, whereby a heavy load was to be fired 300 km instead of 120 km as theretofore. The fifth point was the only technically intricate one. It meant the realisation of an artillerist's ideal, an ideal from which the heaviest artillery had wandered further and further away : for setting up the 70-cm (?) Sebastopol gun, it required the combined efforts of 500 men during six months.

Meanwhile, the project represented such an extensive scientific innovation that the development naturally entailed a great amount of research. The question repeatedly arose of whether the work was worth while, whether the final result would really compensate for the vastness of the preparations. It is therefore not astonishing that the task, begun in Kummersdorf and continued on a large scale in Peenemünde after 1937, had repeatedly to contend with the severest of obstacles. Ultimately, a point was reached when the military research authorities at Peenemünde engaged the permanent services of an Ufa cameraman in order to make propaganda films for the high command, thus to gain more and more support for the idea, as well as to show the progress made. Then, after the war broke out, the project became less and less urgent, particularly in view of the initial German successes and the belief that the hostilities would not last long. As the first firing trials did not come up to military expectations, the question was considered even in 1942 of whether it was not wiser to put a stop to the development work. But only a few days before the decisive reply was to have been delivered, the first shot proved successful. The urgency immediately reached a climax. All efforts were concentrated on completing the V 2 and orders were issued to prepare for large-scale serial production.

During the final race, the great Allied air offensive occurred, in August 1943. The result was that much time was lost and the extensive decentralisation measures which suddenly became necessary made it difficult for the efforts to be co-ordinated.

In addition, serious setbacks were soon experienced, which were partly to be attributed to technical reasons, but also partly to developmental causes. Towards the end, repeatedly heavier demands were placed on precision and " the tightening of every screw. " Furthermore, the steering mechanism and the cease-power controls were revealed to be insufficiently accurate. The greatest difficulties of all were encountered in connection with the final explosion apparatus. A great percentage of the missiles exploded after describing a perfect flight path, at an altitude of about 3 km, three to four seconds before reaching the target. A new, enormous effort was made, and several months' production was scrapped.

In view of the critical military situation, the order was given in October, 1944, for the V 2 to be put into tactical operation, despite the fact that all the problems had not by then been solved and all the mistakes had not been rectified.

Technical Details and Construction

The size of the apparatus was decided by the requirements stipulated, so that roughly the following data ensued :

Total weight	14 tons
Weight of fuel	9 tons

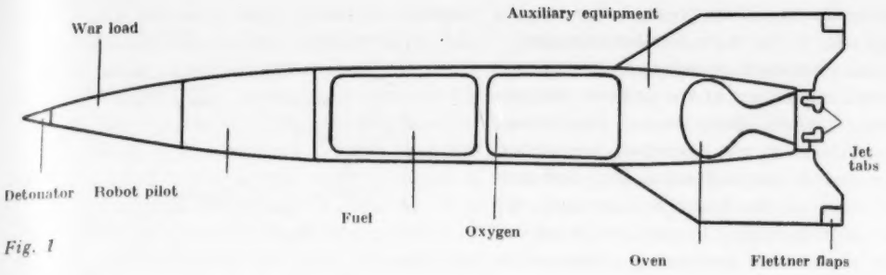


Fig. 1

Useful load	1 ton
Initial thrust	25 tons
Max. thrust gain with altitude	4 tons
Initial acceleration	1.75 G
Effective initial acceleration	0.75 G
Final acceleration	6.5 G
Range	300 km
Max. altitude	90 km
Flight duration	300 sec.
Propulsion duration	66 sec.
Vertical climb	10 sec.
Internal combustion pressure	15 atm
Outlet pressure	0.9 atm
Smallest nozzle diameter	400 mm
Outlet nozzle diameter	740 mm
Nozzle aperture	25 deg.

The overall construction and external form of the missile is shown in Fig. 1.

The propulsive jet functions at constant internal combustion pressure (or oven pressure, as the Germans called it) and, accordingly, entails a constant rate of fuel consumption. Nevertheless, the effective thrust is not constant. The decrease in static pressure with altitude results in a gain in thrust. This, together with the loss in weight of the missile as the fuel is consumed, denotes a relation between the acceleration and the combustion duration. Apart from this, the gradual emptying of the fuel tank entails a temporal displacement of the centre of gravity, a circumstance which bears heavily on the question of aerodynamic stabilisation. Once the flight path has been determined, it is important, from the aerodynamics standpoint, to know the relations of altitude h, pressure p, density ϱ, temperature T, speed v, $Ma=f(v,T)$, dynamic pressure $q=\frac{1}{2}kMa^2p$ (with $k=C_p/C_v=1.405$).

These relations are above all necessary for investigating the influence of jet streams (combustion stream) on aerodynamics, the influence of the Reynolds Number, and for obtaining the surface temperature. For these data, the ordinary transfer of the usual non-dimensional descriptions is no longer possible. Hence, the data in this connection, given below, only apply to this special case and cannot be transferred arbitrarily. The nevertheless partially non-dimensional description has been chosen solely to provide a better overall picture of the relative importance of the various effects.

Data for the Mechanics of Flight

The precise demands placed upon the apparatus which was to be developed made it possible to determine roughly what constructional elements, and of what size, were necessary. Supersonic speeds occur during by far the greatest part of the trajectory. For the ascending branch, the maximum dynamic pressure worked out at approximately 8,000 kg/m² for $Ma=2.5$, and for the descending branch, after the atmosphere had been pierced, at some 40,000 kg/m² for $Ma=4$. This speed range was therefore decisive, calling for particularly careful investigation. The result was that the determination of the fuselage form with respect to low drag was carried out solely from the standpoint of supersonic aerodynamics. The guiding principles were maximum slenderness of the fuselage and minimum angle of aperture of the pointed tip. On the other hand, constructional considerations placed limits on the permissible slenderness, this in order that, with regard to tensile stresses, a feeble drag should not become ineffective, or eventually detrimental, because of too high a constructional weight.

In the end there remained so little freedom of variation that, renouncing the wind tunnel investigations, the fuselage form was decided upon *a priori* by aerodynamic intuition, taking heed of the constructional consequences. This enabled a considerable amount of time to be gained, and seemed to be all the more justified by the fact that the major part of the trajectory passed through a practical vaccum, so that no capital importance needed to be attached to the strength factor as far as the firing range was concerned.

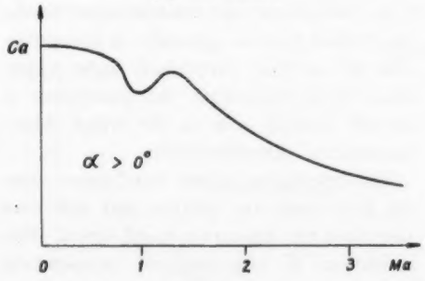
The problem of stabilisation was likewise unclear. After a series of measurements for low, subsonic speeds and a number of trials at supersonic speeds, the form and size of the stabilising surfaces were determined. One point was clear, namely, that these surfaces had to be as thin as possible. Here again, nevertheless, the construction was carried out without precise knowledge of the anticipated distribution of the forces, though all the same with heed to security in this respect.

One danger overshadowed the entire project: the fact that the sonic barrier had never been completely pierced by a free-flying body. Preliminary calculation revealed that the time available for stirring up an oscillation, taking into account the thrust and the familiar moment of inertia in the critical sonic region, was exceedingly short. Apart from this, a great amount of confidence was given to jet tab control. This was governed solely by the propulsive jet, flowing at supersonic speed, and which, it was believed, was not to be influenced by the exterior flow piercing the sonic barrier. Hence, this problem, though not fundamentally solved, was also regarded as having been surmounted.

The exterior form was established. The aim of the aerodynamic investigations was now to obtain the exact data, verify the numerous preliminary conditions made, and to supply detailed information for the mechanics of flight, control, and construction.

The most significant measurements of all were those of which the results were to serve towards precise calculation of the flight path. These were lift, drag, and the position of the centre of pressure (measured from the rear), represented as non-dimensional coefficients, c_a, c_w, and H/D, in function of the Mach Number. Determination of the flight path was a preliminary condition for all further considerations and developments. Apart from this, these results could be obtained by three-component measurement. The character of the lift, which is proportional to the angle of incidence, and of the centre of pressure, may be determined from the considerations which already applied in the case of bullets (Fig. 2 *a*, *b*).

(*a*) Lift value



(*b*) Centre of pressure position

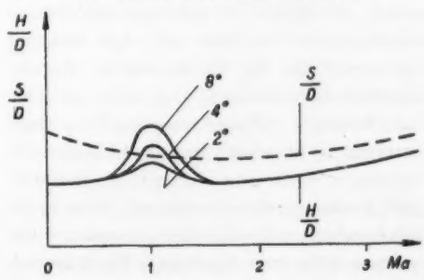


Fig. 2

These diagrams require no further elaboration. All that should be noticed is, in the centre of pressure diagram, the course of the centre of gravity, which results from the gradual emptying of the fuel tank.

For the first time in this article we find, in Fig. 3, the character of the drag, measured on the wind-tunnel model. Here, as in other cases, the contours for the values between Ma = 0.95 and Ma = 1.22 have been interpolated according to the assumed tendency.

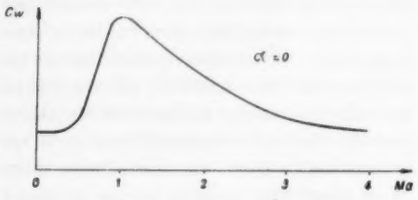


Fig. 3. Drag coefficient

In order to clarify the character of the drag, it is best to investigate its two components separately : (*a*) the part determined by the external form, and (*b*) the friction part which is proportional to the outer surface and caused by the internal friction. The first part, originating solely from the form of the body and the Mach Number, may be transformed arbitrarily by dynamic pressure and characteristic surface for other values and flows. The friction part, however, is dependent upon the Reynolds Number and cannot therefore be transferred in the same manner. The non-dimensional description is thus misleading, but utilisable.

According to the potential theory, at subsonic speeds there is no form drag as long as the flow lies entirely along the body ; this applies to the V 2 as far as the obtuse rear. Hence, this is the only form drag, a circumstance which is also confirmed by the measurements, and it amounts to about 35 per cent of the total drag ; the remainder is friction drag. Up to the normal range of sonic speeds, in confirmation of the theory, the character of the drag reveals itself to be only very slightly dependent upon the speed.

Quite different conditions apply to the supersonic region. Here, the theory itself states that form drag exists, which, apart from the form of the body, is also dependent on the Mach Number. This may be represented by means of pressure distribution measurements, as these only deal with the form, and not the friction forces (Fig. 4). The form drag does not, as is often assumed, take its origin solely in compressibility losses incurred by the head wave. At supersonic speeds, a form drag, except for infinitely thin plates, is always existent, even if the head wave is not taken into account. Comparison of the two diagrams in Fig. 4 immediately shows, from the decrease of the absolute values of the pressure, that the drag decreases as the Mach Number increases.

One phenomenon is immediately noticeable from examination of the pressure distribution. It is the sharp drop of the pressure distribution at the transition points from the nose to the cylindrical part and from the latter to the rear. At first sight, this seems to be highly improbable, in view of the smooth and harmonious course of the contour. In point of fact, it precisely confirms the result of theoretical considerations. They indicate a characteristic peculiarity of the supersonic flow. Thus it is not the continuity of the contour which is the defining factor for the flow character, but the differential quotient according to the length, thus the tangents to the contour (Fig. 5). The character of these also shows drops at the aforesaid points.

The situation is somewhat more complicated when it comes to calculating the friction drag at supersonic speeds. The friction coefficients as functions of the Reynolds Number have only been investigated for subsonic speeds. The question arises as to how far these data can be transferred to supersonic speed conditions.

The supposition that a direct relation does exist is correct, as subsonic speeds are generally existent in the boundary layer. Basing his statement on theoretical considerations, Busemann says that the friction coefficient must generally be about one third lower at supersonic speeds than at subsonic speeds, with the Reynolds Number remaining the same. This effect is explained by the sharp temperature rise in the boundary layer. The drag coefficient calculated therefrom showed, for the wind-tunnel model at supersonic speeds, no great dependence on the Mach Number. Thus the decrease in drag with the increase in Mach Number, discernible from Fig. 4, is not due to the friction part, but chiefly to the form part.

What conditions apply to the friction part in the supersonic regions ? The theory gives practically no clue in this connection. Let us then revert to the measurements, extending from both sides to near to sonic speed ($Ma = 0.9$ and $Ma = 1.2$), and interpolate. The " measured " friction coefficient then reveals itself as the difference of the total drag coefficient and the pressure distribution measurement (Fig. 6).

As calculation and measurement reveal the friction parts as generally in accordance with one another, particularly under supersonic speed conditions, the calculation is plotted (dotted) only in the region where fundamental differences occur.

The description shows that, apart from the form part, the friction part also rises sharply in the supersonic speed region. This revelation is new and of fundamental significance, for the tendency had been to

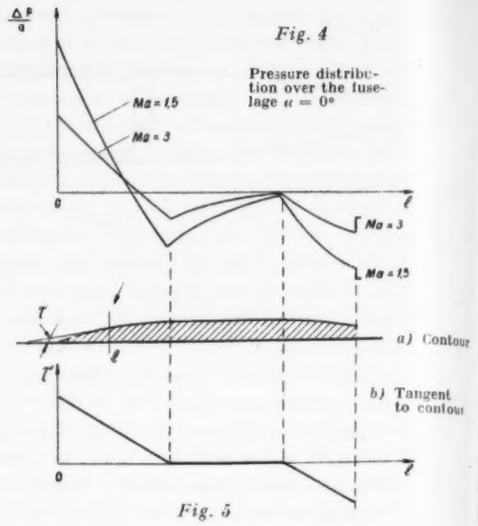


Fig. 4

Fig. 5

attribute the increase in drag solely to the form part. It is explained by the fact that local subsonic speeds and shock waves cause pronounced swellings in the boundary layer. This influences the stability of the flow and, as a result, can easily cause a break-away of the boundary layer. In consequence, it seems that a reciprocal shaking-up of the boundary layer and flow disturbances occurs, which results in the well-known, highly-unpleasant phenomena. Hence, the structure of the drag curve in Fig. 3, measured for the model, is explained. The problem is now to determine the necessary corrections of this curve in order that it may be valid for the final missile.

Seeing that the Reynolds Numbers for the wind-tunnel model move between 10^6 and 2×10^6, a range within which the friction coefficient varies only very little, the transition to the full-size version involves a considerable jump. The actual missile entails Reynolds Numbers ranging from approx. 10^8 to 3×10^8, corresponding on the average to about half the friction coefficient applying to the model. For the definite sub- and supersonic regions, this dependence can be explained by calculation, but this is not the case for the sonic region. As no better indications are available, it is best also to apply this factor to the sonic region, with the measured friction coefficient taken into account. Thus the correction of the Reynolds influence for the drag coefficient is completed in approximation ; the result is a mean drag decrease of about 12 to 18 per cent.

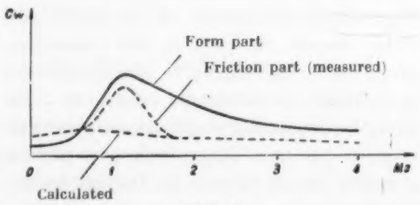


Fig. 6

This influence, which results in a smaller relative thickness of the boundary layer, has, of course, a certain influence on the whole flow around the missile, and thus on the lift and the position of the centre of pressure. Hitherto, it has not been possible to define this effect by calculation, or then, only to a very approximate extent. In practice, it is only possible to make restrictive estimates as to the anticipated tendency. Considering that a small thickness of boundary layer is to be expected in any case, the boundary layer of the fuselage will affect a smaller part of the rear stabilising assembly of the full-size version. As this part will be more fully influenced by the normal air flow, it will be more efficacious. On the other hand, the part played by surfaces near to the fuselage is relatively small, so that the influence cannot be very considerable. Thus, slightly better stability may be reckoned on for the full-size version. With this, only insignificant changes are to be expected as regards lift and centre of pressure position ; but they will invariably be advantageous from the mechanics of flight point of view. In the region of the sonic barrier, the influence will probably be relatively much greater, though also only in the way of an amelioration.

From this, the following decisive conclusion may be drawn for future projects of this kind : if a projectile is dimensioned in such a manner as to prove in wind-tunnel tests that it satisfies every requirement of drag and stability, then these results, eventually even better ones, may be expected for a full-size model in free flight. Thus this problem has been solved satisfactorily for the entire trajectory, except for the actual piercing of the sonic barrier. Up to the free-flight tests, this point constituted the only weak link in the chain of the aerodynamic development. It will be revealed later that an entirely new and altogether unexpected effect occurred in this respect.

Let us now examine the influence of the propulsive jet for the first determinant part of the trajectory. The extreme significance of this examination was made apparent for the first time by a test carried out with a propulsive jet directed rearwards. When the pressure distribution was measured for a speed of 46 m/sec, there resulted a 0.5 D displacement of the centre of pressure, a lift increase of 15 per cent and an increase in drag amounting to 75 per cent.

The propulsive jet of the full-size model has an outlet speed of about 2,000 m/sec. It therefore has a very strong injector effect on the surrounding air. This circumstance would not exist if the air had the same speed. Thus the value of the injector effect depends on the relation between the speed of the exterior flow and that of the jet, with the result that it decreases if this relation approaches " one, " and amounts to zero if the relation is worth " one. " The effect consists of an aspiration of the air surrounding the jet. This causes a corresponding supplementary flow and, hence, an acceleration of the air around the rear of the body. A superior speed of flow brings about a decrease in pressure and, acting principally at the rear, an increase in drag. Apart from this, measurements revealed that there was also a partial increase in lift and in the normal forces around the rear.

Our considerations have shown that the effect of the jet, measured at very low speeds, must diminish continuously for an accelerated projectile. Independently of this, the theory of gas dynamics demands that this effect disappear as soon as supersonic speed is attained in the exterior flow, for, at supersonic speeds, no phenomenon occurring downstream can be effective up-stream, at least as long as there is no boundary layer influence.

The effect of the jet would therefore have to decrease if the speed were increased, and disappear entirely as soon as supersonic speed were attained.

It could not be discerned at that time whether this effect would still exist in the adjoining region, and if so, under what form. Let us then start off again from the results of the tests. In Fig. 7 the drag variation caused by the jet is plotted against the Mach Number. It confirms the result for subsonic speeds which was derived by deliberation. The quantitative exactitude is all the same doubtful. The same conditions of pressure were easily obtained in the wind tunnel, but it was not possible to equalise the temperatures of the propulsive jet and the exterior flow. The relation between the speeds is therefore not correctly revealed. The real influence can thus be considerably greater at subsonic speeds ; however, further tests in this regard were not executed.

It is interesting to note that measurements revealed a jet influence for supersonic speeds also, namely, a decrease in drag up to 18 per cent. This was more, and more favourable, than was hoped for. Fig. 8 contains results obtained by Schlieren photography which explain this phenomenon.

It is clear that this effect is due to fundamentally different causes. Fig. 8 *a* shows the jet at low subsonic speed, running parallel because its pressure is equal to that of the exterior flow. The Mach waves correspond to the jet speed. The missile gains altitude at the same time as the speed augments. The exterior air pressure diminishes accordingly. This results in the jet's expanding until equal pressure with the vicinity occurs, increasing, namely, with the Mach Number of the missile. The expanded jet forms a bell-shaped gas body aft of the tail (Figs. 8*b*, *c*) which has the same effect on the exterior flow as would a solid body. The result is a corresponding rise in pressure and the formation of shock waves at supersonic speed. The pressure increase is led a little forwards along the rear by the subsonic boundary layer and the turbulent after-flow. According to Fig. 8 *c*, the boundary layer breaks away entirely at Mach 3, with the result that the flow continues at a tangent to the cylindrical section. In this way the pressure increase is transmitted to the entire rear. These results wholly clarify the drag decrease by the jet influence, and its tendency. The cause is new. Whereas the influence at subsonic speeds is based on the kinetics of the jet compared with the exterior flow, the process at supersonic speeds is of a purely stationary nature and due to flow conditions.

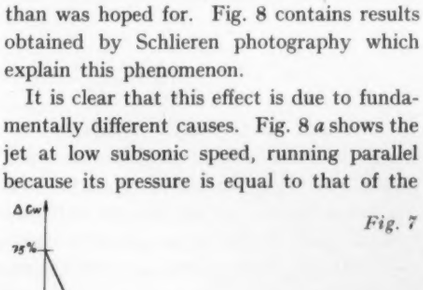


Fig. 7

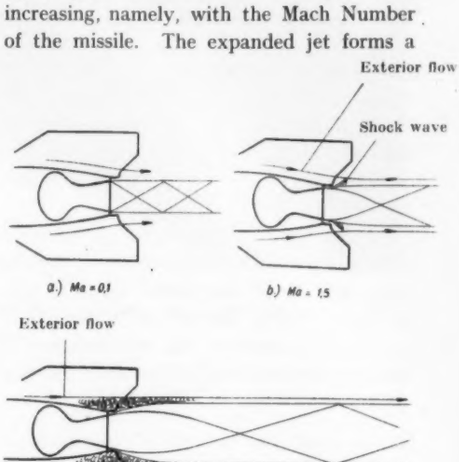


Fig. 8

In contrast to subsonic speed conditions, the measured results for supersonic speeds are quantitatively correct. But they are only precise for a special trajectory. The flow conditions change if the altitude and speed are arranged differently. From a purely quantitative standpoint, however, the result is nevertheless of general importance.

Examination of the Schlieren photos reveals that the influence at supersonic speeds is limited to the region near the fuselage. No great influence on lift and centre of pressure position is therefore to be expected ; check measurements confirmed this.

In order to group the aerodynamic findings so that no gaps remain, and to establish their absolute accuracy, it is nevertheless necessary to check the reliability of the interpolations

made for the sonic region. It should at least be confirmed that no unexpected effects will occur during the piercing of the sonic barrier. Actual tests in free flight turned out to be the only possible way of doing this.

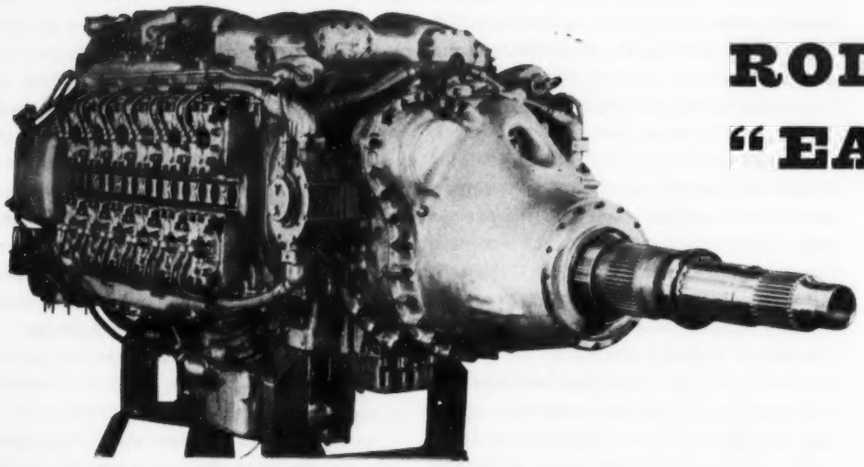
For this purpose, rocket missiles were built, but without any controls. They measured about 1.7 m in length. The propulsion and fuel supply were adequately dimensioned, so that, according to the available aerodynamic data, the test missiles should attain supersonic speeds. The flights were to be controlled visually and measured with cinematographic theodolites.

At first, the findings were a complete surprise and a great disappointment. Shortly after the take-off, the missile began to turn on its own axis. This was first thought to be of no consequence and uninteresting ; it was attributed to irregularities in the external form or in the propulsion. But at higher speeds, the entire missile began to hunt, with amplitudes which grew with the speed in such a manner that the total thrust was balanced by the drag when sonic speed was approached. These tests were repeated time and time again, with different thrusts and the acceleration varied between 2 G and 12 G, and continued to show the same result. The sonic barrier could not be pierced.

The circumstance was mysterious and gave cause for anxiety until Schneller, with the help of very thorough calculations, proved in his dissertation that the existence of twist around the longitudinal axis must necessarily cause hunting. This was confirmed in the wind tunnel by oscillation measurement with three degrees of freedom and a motor-driven rear. Two conclusions were to be drawn : firstly, it showed the necessity of twist balance for the full-size missile in a totally different light ; and secondly, it renewed confidence in the aerodynamic measurements.

The next aerodynamic step in this direction was to drop a solid steel body from an aeroplane at 7,000 m. This test proved successful. Cinematographic theodolite observation proved that supersonic speed had been attained. Unfortunately, the measurement was not sufficiently accurate to form also the second derivation of the path in function of time, thus the character of the acceleration. The aeodynamic measurements in the wind tunnel, and their interpolations, had therefore been confirmed qualitatively, though not quantitatively.

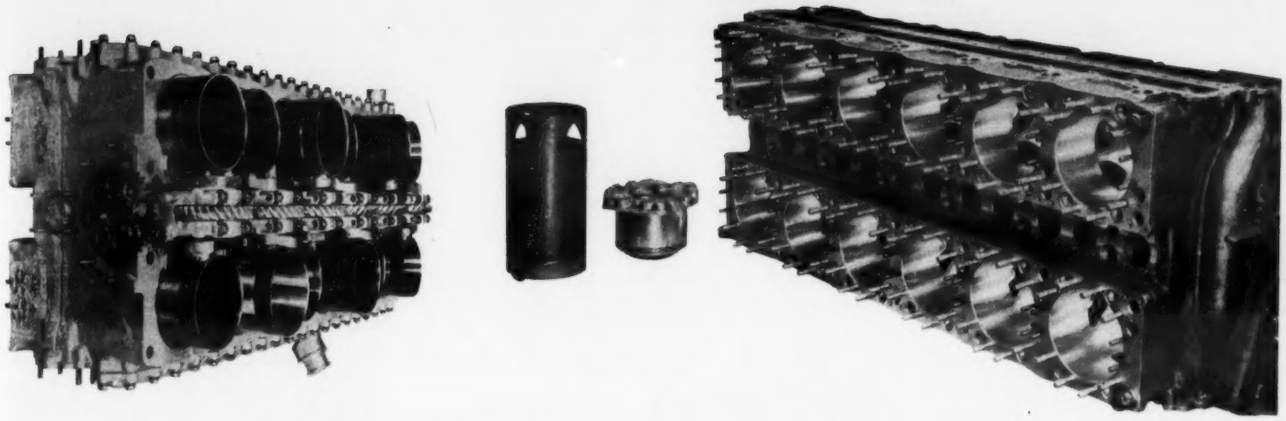
(To be concluded next month.)



ROLLS-ROYCE "EAGLE"

Rolls-Royce, Ltd., of Derby, England, have chosen a famous name for their latest piston aero engine—" Eagle. " For the very first Rolls-Royce aero engine, which this renowned automobile concern began building in September, 1914, for the British Admiralty, and which underwent its test bench trials the same year, likewise bore this name. It was a liquid-cooled twelve-cylinder type of 350 H.P. Two such " Eagle " engines were fitted to the Vickers " Vimy " biplanes in which Alcock and Brown made the first Atlantic crossing from Newfoundland to Ireland and Ross Smith pioneered the England-Australia " Empire " route in 1919, and in which Van Ryneveld made the first flight from London to Cape Town in 1920 ; the " Eagle " powered the single-engined de Havilland D.H. 4's which, in 1919 and 1920, like the " Halifaxes " and " Lancastrians " a quarter of a century later, fulfilled the transition from military to courier aircraft and finally to the commercial transports for the oldest of British air services, that from London to Paris ; moreover, the two Dornier-Wal seaplanes with which Amundsen, Riiser-Larsen and Ellsworth undertook their Polar flight in 1925, were also equipped with " Eagle " engines (Mark IX versions). Anybody to whom the name does not sound familiar may be envied for his youth !

The first " Eagle " headed the long list of Rolls-Royce liquid-cooled engines named after birds of prey, the majority of which continued to be developed and produced as sub-versions for years afterwards : " Hawk, " " Falcon, " " Condor, " " Kestrel, " " Buzzard, " " Merlin, " " Peregrine, " " Vulture, " " Griffon "—the latest and perhaps the last



Left to right : 1. The side of the cylinder block adjoining the crankcase (rear end) showing the sleeves and driving worms ; the worm wheels mesh with a common sleeve drive worm. 2. Sleeve. 3. Cylinder head. 4. Cylinder block seen from the outside (front end).

of which again bears the name " Eagle. " This model is a 24-cylinder flat " H " type engine with two crankshafts ; it has a nominal output of 3,500 H.P., thus ten times that of its namesake of over thirty years ago.

In a few years, the high-power reciprocating engine will probably have to give place to the jet engine and gas turbine, in the development of which Rolls-Royce figure prominently ; in this field the names of the birds of prey have been replaced with names of English rivers : " Welland, " " Derwent, " " Nene, " " Trent, " " Dart, " " Clyde "... But the adoption of these types of power plant entails new conceptions of speed, altitude and range, and thus revolutionary changes in aircraft design as a whole. Until these are accomplished, and where they seem to be fundamentally impossible, the high-power piston engine will continue to conserve its own field of application.

The Rolls-Royce " Eagle " was already tried out in the air last year, in a new single-engined fighter, the " Wyvern, " developed for the Admiralty by Westland Aircraft Co., Ltd. The characteristics and performance of this Naval fighter are still a military secret ; at the most it could be assumed that the Naval Air Service made demands of this aircraft, which could only be fulfilled by a propellor-driven type, and that they had no wish to await the perfection of a high-performance gas turbine, ready for production and operation. A new, high-performance British piston engine had, therefore, to fulfil a definite requirement.

Rolls-Royce have always adhered to liquid-cooling, which has enabled them to increase the effective mean pressure and thus the output of their engines progressively and considerably, without increasing the r.p.m. or compression ratio, simply by developing the supercharging system. At the same time, the power curve in function of altitude could easily be adapted to the operational requirements of each aircraft type. The maximum output of the " Merlin, " for instance, was 1,025 H.P. for the first version (1936) with single-stage fixed reduction-gear ratio supercharger (5 3/4 lb./sq.in. boost), and it was stepped up ten years later to nearly double the output, 2,030 H.P., with a two-stage two-speed supercharger and intercooler (25 lb.sq.in. boost). The " Eagle, " which is of course also liquid-cooled, does not take up its development precisely from where the " Merlin " left off. The bore and mean piston speed are identical in both types, so that one could expect the " Eagle " which, with its 3,500 H.P., is probably the most powerful reciprocating engine in the world that has so far been flight-tested, to deliver twice the output of the " Merlin, " thus over 4,000 H.P., in the none too distant future. Meanwhile, the documentation as yet released does not reveal at what boost and mixture aspiration temperature the present 3,500 H.P. are reached.

Incidentally, the two-stage two-speed supercharger of the " Eagle " is not entirely identical with that of the " Merlin. " Whereas in the latter the mixture is led between the first and second stages through a special intercooler, the " Eagle " has only a small intercooling system inside the supercharger casing. In contrast, larger aftercoolers are located between the supercharger outlet and the cylinders.

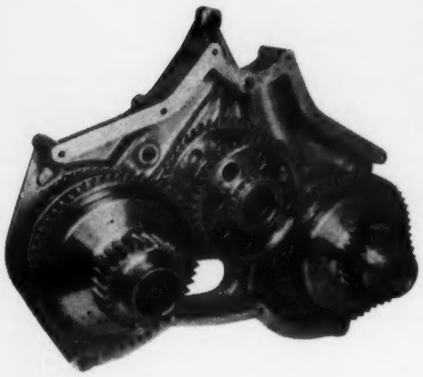
The most significant difference between earlier Rolls-Royce engines and the " Eagle " is the fact that the latter incorporates sleeve valves. Although all the firm's previous production engines featured poppet valves, sleeve valves are not entirely new to them as they started conducting research in this direction already before the war.

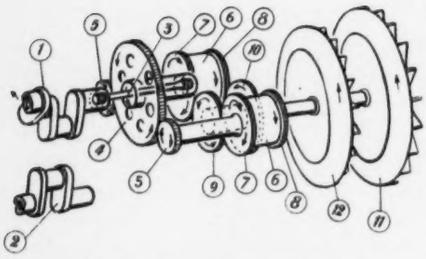
The crankcase of the " Eagle " is split in the plane of the two crankshafts ; each half has seven stiffened lateral webs, carrying seven bearings for the upper and lower crankshafts. To the left and right of the crankcase are two cylinder blocks, forming single castings, each with an upper and a lower row of six cylinders. The two blocks and the crankcase halves are held in compression by twenty-eight high tensile steel tie rods which pass through the engine and are nutted on the external face of the cylinders. To the front of it is locked the airscrew gear casing and to the rear, the supercharger casing.

Each of the two crankshafts has four counterweights, the rear one of which bears a torsional damper. A spur wheel at the forward end of the lower shaft engages directly with a spur wheel on the upper shaft, so that the two crankshafts turn at the same angular speed in opposite directions. The ignition takes place simultaneously in one of the six upper cylinders and in one of the six lower cylinders, always at equal distances from the middle dividing plane, so that all forces and moments of inertia are in equilibrium ; inside each cylinder row, the usual six-cylinder firing order applies : 1-4-2-6-3-5.

The cylinders are ventilated by sleeves, each of which features three inlet and two exhaust ports. The inlet manifolds for the two cylinder rows of each side are above and below the block, while the outlets discharge into a lateral passage between the cylinders, to which is coupled a conventional exhaust collector.

The sleeve drive for each of upper and lower cylinders is by a common vertical shaft with two spur pinions, each of which engages with a spherical journal in an eye at the base of the sleeve, and gives the sleeve a combined axial and rotational movement. The sleeve-crank shafts turn on bearings fixed to the cylinder blocks ; each carries a worm wheel in the middle, which engages with a worm shaft running parallel to the engine shaft between the cylinder rows. To





Supercharger drive from rear end of upper crankshaft: 1. upper crankshaft, 2. lower crankshaft, 3. torsional damper, 4. drive wheel, 5. pinion of layshaft, 6. centrifugal coupling actuated by fixed pressure-oil cylinders, 7. high ratio clutch, 8. low ratio clutch, 9. gear wheel on supercharger shaft for high ratio, 10. same for low ratio, 11. first-stage impeller, 12. second-stage impeller.

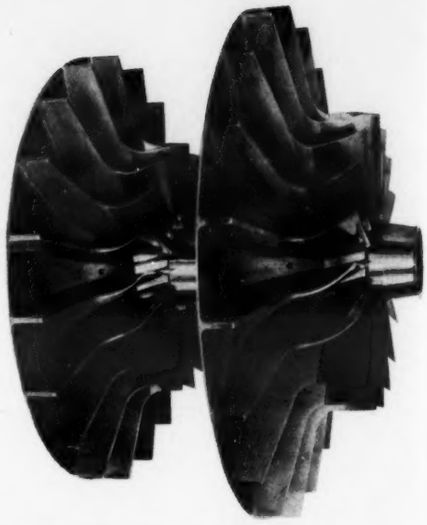
balance the axial forces, the leads of the front trio of worms and worm wheels are arranged oppositely to those of the rear trio. Both worm shafts, that of the left and that of the right cylinder block, have spur wheels at the rear ends, through which they are driven by the upper crankshaft.

As is generally the case with sleeve-valve engines, the cylinder heads, fastened to the block with twelve adjusting screws, have cylindrical continuations which penetrate into the interior of the sleeves and are sealed off from the latter by two piston rings in each case. The interior of each cylinder head is connected with the water jacket of the cylinder by four openings in the lateral passage, thus admitting the coolant.

The cooling is designed according to the so-called " shunt " system, in which the main circuit is completely closed and includes no proper reservoir. A pump attached beneath the crankcase delivers through the cylinder blocks to swirl-type outlets at the top of the blocks, then to the radiator and back again to the pump. These swirl outlets separate the vapour from the coolant and pass it to a header tank mounted on top of the engine. This header tank acts as a reservoir for coolant and is connected to a venturi at the pump inlet. Should any decrease in pressure occur at the pump, due to cavitation, it is immediately restored by a flow of coolant from the header tank to the venturi.

The main bearings and big ends are lubricated from the hollow interior of the crankshafts. The worm shafts for the sleeve drive are also hollow to convey main pressure oil to their bearings and those of the sleeve-crank shafts.

The fact that over 1,000 H.P. must be transmitted to the supercharger makes it evident that it is much more than a mere auxiliary group and that it plays a decisive part in increasing the " Eagle's " performance at all altitudes. The impellers of the two-stage two-speed supercharger are mounted on a common shaft and are driven by the rear end of the upper crankshaft, through a torsion coupling and two layshafts. Each of these bears two gear wheels of different diameter, which mesh with corresponding wheels on the supercharger shaft and can, if desired, be driven through a centrifugal coupling. The gear change is effected by a hydraulic ram housed in the wheelcase and linked by a forked rod to a sliding cylinder in each layshaft. The supply of oil to the ram can be controlled by either manual operation of an electromagnetic valve or by an aneroid functioning in accordance with the altitude.

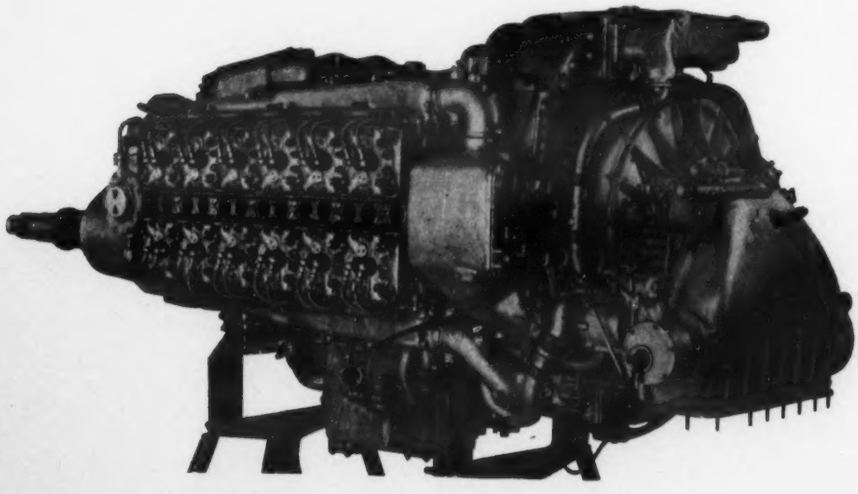


Impellers of the two-stage supercharger.

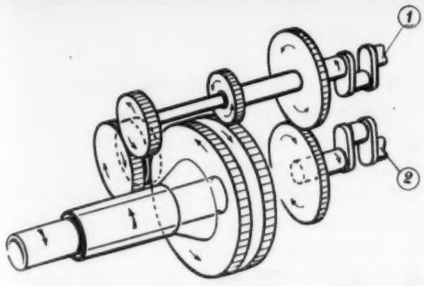
Air enters the supercharger from the rear and underneath through a wide elbow which leads it to the axial opening of the casing. An oil-heated rotary slide valve of cross-section in the form of a segment of a circle is built into the wide lower part of this elbow for regulating the quantity of air, while the upper part contains the fuel injection nozzle which is directed against the opening of the supercharger. The fuel is supplied under pressure to the nozzle by an injection pump located beneath the crankcase ; this is a five-plunger pump operated by a swash-plate, stroke and capacity being varied by alteration of the angle of the swash-plate.

Intercooling of the mixture is provided by vane annular passages in the supercharger casing between the first and second stage impellers. The second stage impeller leads the mixture through an annular diffuser to four tangential outlet points, from which it enters four cube-shaped aftercoolers arranged around the casing. For the intercooling inside the supercharger, and the aftercooling, there is a common coolant circuit which is separate from that for the cylinders and of course requires that the aircraft be fitted with special radiators. Finally, the mixture is fed from each aftercooler to the nearest row of cylinders.

As a rule, an engine of this output is destined to drive a pair of contra-rotating airscrews ; the " Eagle " has, therefore, two co-axial airscrew shafts, the inner shaft being for the front airscrew and the hollow outer shaft for the rear one. The upper crankshaft



View of the " Eagle " with supercharging system.



Layout of the reduction gear for the two contra-rotating airscrews.
1. Upper crankshaft 2. Lower crankshaft.

bears two spur wheels, the rear one meshing directly with a larger wheel on the inner airscrew shaft and the front one driving the outer airscrew shaft via a layshaft. The axial forces are transmitted from the inner airscrew shaft over two large ball-type thrust-transfer bearings to the rear end of the outer shaft, and then through a similar bearing to the front end of the casing.

The fact that the casing and thus the entire engine is relatively long is due to the slender nose of the above-mentioned Westland aircraft. But more important than the overall length is the frontal area ; the photos show that in the " Eagle ," as in its predecessors, the designers have succeeded in arranging such cumbersome accessories as the aftercoolers and coolant tank so compactly around the body of the engine and the supercharger that the frontal area is kept to a minimum. By not counting the frontal area of the radiator, which can be mounted elsewhere on the aircraft, one is justified in saying that the " Eagle " delivers no less power per square foot frontal area then many a propeller-turbine. T.

Characteristics, Performance and Consumption of the 24-Cylinder Rolls-Royce " Eagle "

Bore	5.4 in.
Stroke	5.125 in.
Total swept volume	46 litres
Total piston area	549.6 sq. in.
Overall length	135.5 in.
Overall width	43.5 in.
Overall height	50.0 in.
Frontal area, actual	10.6 sq. ft.
Reduction ratio (both airscrews)	1 : 0.2985
Contract dry weight	3,900 lbs.
First-stage impeller diameter	19.5 in.
Second-stage impeller diameter	17.0 in.

Performance

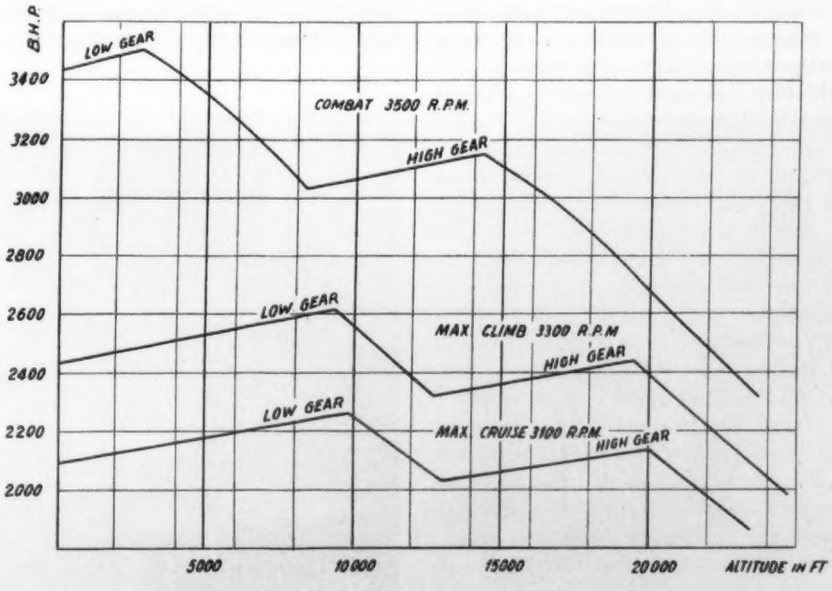
	Supercharger gear ratio	
	1 : 3.00	1 : 3.67
Max. power at 3,500 r.p.m. (combat or emergency power)	3,500 H.P. at 2,750 ft.	3,150 H.P. at 14,250 ft.
Max. climbing power at 3,300 r.p.m.	2,620 H.P.	2,450 H.P.
rated boost, abs.	12 lb./sq.in.	
rated height	9,500 ft.	19,500 ft.
Max. cruising power at 3,100 r.p.m.	2,270 H.P.	2,140 H.P.
cruising boost, abs.	9 lb./sq.in.	
rated cruising altitude	10,000 ft.	20,000 ft.

Comparative values for maximum power

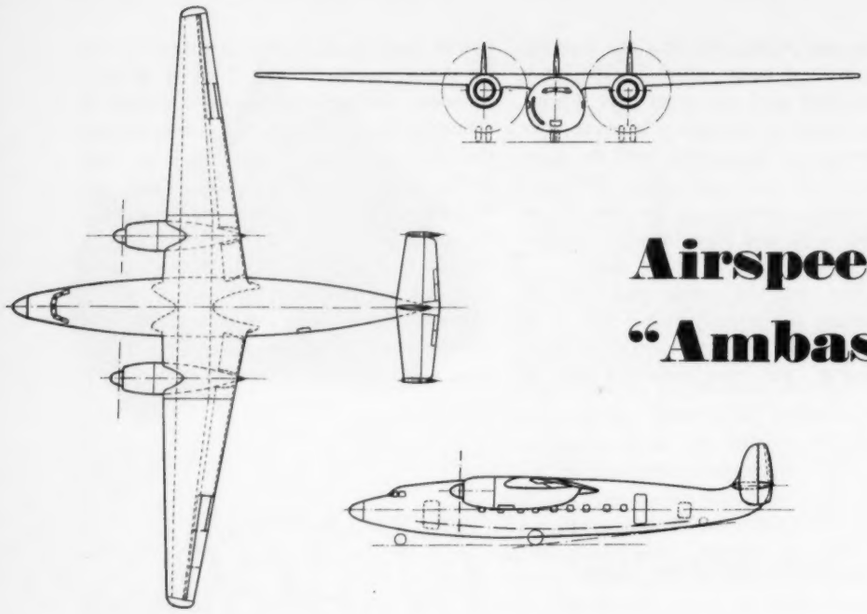
Mean piston speed at 3,500 r.p.m.	5 ft./sec.
Effective mean pressure	282 lb./sq.in.
Power/litre	76 H.P.
Power/sq.in. piston area	6.375 H.P.
Power/sq.in. frontal area	328.5 H.P.
Specific weight	1.12 lb./H.P.

Fuel consumption

Max. consumption at 14,250 ft.	350 gall./hr.
	or approx. 0.80 lb./H.P. hr.
Take-off consumption at sea-level	342 gall./hr.
	or approx. 0.72 lb./H.P. hr.
Climbing consumption at sea-level	176 gall./hr.
	or approx. 0.525 lb./H.P. hr.
Max. cruise consumption at sea-level	142 gall./hr.
	or approx. 0.49 lb./H.P. hr.



Power curves for the Rolls-Royce " Eagle Mark 22. "



Airspeed A.S. 57 "Ambassador"

During the final phase of the war, when the aircraft industry of the belligerent nations was still totally occupied with the manufacture of necessary military aeroplanes, plans were already being elaborated for the post-war production of flying equipment. It was realised at that time that the competition in future air transportation would call for modern, high-performance commercial transports, cheap in operation, and that the aircraft in existence at the beginning of the war could in no way fulfil these requirements.

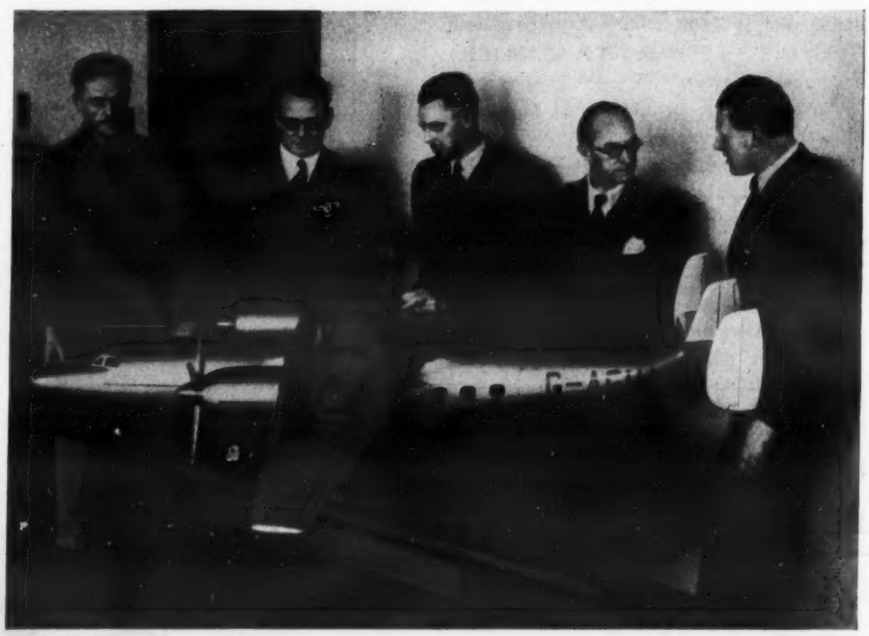
Whereas the American aircraft manufacturers had acquired a considerable advance with their development of military transport aircraft which could later be built as passenger planes without any substantial modification, the British aircraft industry, because of its having devoted itself almost entirely to fighter and bomber types, found itself forced into the background. With this circumstance in mind, a committee was formed in England under the chairmanship of *Lord Brabazon of Tara*, which established a programme of civil aircraft types to be produced in anticipation of the needs of air transportation, and which worked out the developmental data in this connection. This committee and its programme are generally referred to as the *Brabazon Committee* and the *Brabazon Programme*, respectively, and the specified aircraft as the *Brabazon Types*.

One of these Brabazon Types, to be precise, the Brabazon 2a Type, concerns the twin-engined *Airspeed A.S. 57 "Ambassador."* The specifications called for a medium-range transport for connecting the British Isles with the Continent, and *Airspeed Ltd.* was the firm chosen to develop it.

The first prototype of the "Ambassador" may already have accomplished its first trial flight by the time these lines are in print. This aeroplane is not a transitional type derived from an existing military plane, but truly constitutes Britain's first post-war civil transport aircraft. It will serve to prove that Great Britain is beginning to catch up with the American advance, for the "Ambassador" will surely be able to measure itself against the American Convair 240 and Martin 2-0-2 types; in the words of its designer, Mr. A. E. Hagg, "the Ambassador" will have everything its American competitors have, and in some respects, a little more".

General

The external aspect of the "Ambassador" is revealed in the general arrangement drawing: it is a twin-engined high-wing monoplane with an all-up weight of 47,000 lbs., featuring a retractable tricycle undercarriage and possessing, as characteristic, three singularly-shaped vertical stabilisers. As regards utility, it may be compared with the Convair 240, as both types are capable of transporting forty passengers at cruising speeds up to 300 m.p.h.



A model of the "Ambassador" and the men responsible for its design and construction: (left to right) J. F. Foss, Chief Aerodynamicist; A. E. Ellison, Assistant Chief Designer; C. Chapleo, Chief Structures Engineer; A. E. Hagg, Technical Director and Chief Designer; G. P. Jewett, Assistant Designer (Development).

A survey of modern aircraft in this category reveals almost nothing else but low- or mid-wing monoplanes ; a high-wing monoplane, the " Ambassador " stands aloof. It is plain that in this arrangement, the designer took the passengers' standpoint —in addition to other considerations, of course. As a rule, the height of the wing position of a multi-engined aircraft is mainly determined by the amount of clearance necessary between the airscrew tips and the ground, with the result that a high-set wing entails a low setting of the fuselage and hence an entrance door which is accessible without too long a boarding staircase. The floor of the " Ambassador " is only 3 ft. 8 in. above the ground. Furthermore, all the passengers have the advantage of unrestricted downward visibility during flight. From the aerodynamic side, this arrangement also allows for an almost undisturbed wing upper surface.

The prototype " Ambassador " in the constructional stage

Structural details.

To give a full description of the entire structure would be going too far, but the following paragraphs cover certain of the most characteristic details of the construction.

Divided into its main components, the aeroplane is composed of the fuselage, wing centre section with the engine frames and the main undercarriage couplings, and the two outer wing sections.

The fuselage is mainly of reinforced metal monocoque construction, with continuous Z-section longitudinal stringers and rolled channel frames which are notched to allow for the passage of the stringers. The relatively large windows require a substantial amount of stiffening since the fuselage incorporates no proper longerons. At the wind spar stations the fuselage frames are heavily reinforced, assuming the form of box members ; these members extend along either side from the base of the centre-section spars to the cabin floor, and are designed to support the wing loads in the event of a belly landing.

The trapezoidal, two-spar, laminar-flow wing possesses the somewhat high aspect ratio of 11.0. Despite the choice of a proportionately thick aerofoil—its thickness at the roots amounts to 16 per cent of the chord, and to 14 per cent there of at the tips—the high degree of slenderness has permitted a small absolute thickness. The upper wing surface features no dihedral, whilst the tapering gives the lower surface an upward dihedral of a little less than 1½ degrees.

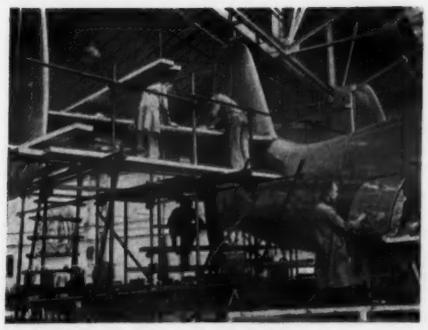
The centre section as well as the outer section of the wing have plate web spars with L-section extruded booms. Whereas the flanges in the centre section are of constant thickness across the fuselage only, and taper-machined spanwise, those of the outer wings are of constant thickness, although the depths of the booms are tapered towards the outboard ends.

The skinning of the wing centre section is reinforced on the upper surface by hat-section stringers, and by Z-section stringers on the lower surface. Diaphragm-type inter-spar ribs preserve the contour, though, in the region of each nacelle, there are five ribs with their diaphragms cut away to permit the later installation of auxiliary fuel tanks.

The outer wings feature basically the same structure as the centre section, but have Z-section stringers throughout, and girder-braced ribs instead of diaphragm-type members towards the tips. At the centre-section/outer-wing joints are two integral fuel tanks, composed of the skinning and the spar webs, providing a total capacity of 1,000 imperial gallons and reinforced by chordal ribs with cut-out plate webs.

Attention is merited by the skin of usually heavy-gauge Alclad sheet which, heavily stressed, can take extraordinary high loads. In point of fact, it takes about 80 per cent of the wing bending loads, leaving the only remaining percentage to the spars. In consequence, the outer-wing/centre-section joints are formed for the spanwise forces to travel directly from the skin of one constructional element to the other, eliminating stress on the spar. For this reason, the spars of the separate wing sections are not connected on

Inside the fuselage of the " Ambassador ." Clearly seen on the nearer wing spar are the diagonal fittings for transmitting the side forces ; and the vertical fittings on the main fuselage frames, which are connected by means of duplicated strapfittings (not visible in photo) port and starboard to each spar and spar frame, and thus transmit the lift loads to the fuselage



The high three-fin tail section of the "Ambassador"

a continuous basis : at the dividing points they have serrated fittings for transmitting vertical and torsion loads.

For the attachment of the wing to the fuselage, a construction has been chosen which transmits lift and side loads separately to reinforced fuselage bulkheads, whereas the wing drag loads are taken as shear via flanged-angle members riveted to the skin of the bottom fuselage centre-section.

For de-icing the wing and tail surfaces, hot air, supplied at 180 to 200°. C. by special heating equipment, is fed through the leading edges. Chordwise distribution of the hot air in the wing is effected by corrugations on the inside of the skin, which extend over 18 per cent of the wing chord and, together with the skin, form the thermal ducts. The air is then exhausted through slits between the skin and the split-type landing flaps.

The retractable tricycle undercarriage was developed in collaboration with Dowty Equipment Ltd. ; each of the three shock struts carries two wheels. The nose-wheel pair is made steerable by a well thought out application of the hydraulic anti-shimmy device, whereby the pilot, using a pistol-butt grip, controls the oil flow to the casing. An electrically-driven hydraulic system provides for retraction of the main landing gear and also actuates the flaps and wheel brakes. This pressure system tops up an accumulator, so that in the case of the electric power's failing, adequate pressure is still available ; moreover, gravity and drag suffice to lower the undercarriage.

Passenger cabin

As the sectional drawings of the fuselage show, the cross-section is composed of two arcs of different radii. As regards pressurisation, this conception is thoroughly satisfactory ; moreover, it provides adequate width of cabin floor without making it necessary to have a deep fuselage. For the accommodation of passengers, luggage, etc., there is a section of 52 ft. in length, the entire space being in no way obstructed by any constructional members.

The fuselage interior gives an impression of spaciousness which is certain to win the passengers' appreciation. The standard seating arrangement is for forty passengers, though this figure can, of course, be increased or decreased according to the range required or the power available.

Ladies' and gentlemen's toilets are provided at the rear end of the cabin ; the galley and baggage compartments are forward. In front of this again is the wireless operator's station and, further forwards, the cockpit with complete equipment for two pilots. Access to the passenger cabin is provided by a door at the rear, while baggage is loaded through a door in the galley, which is also used by the crew ; this arrangement leaves the main cabin free of any unnecessary traffic. Cabin ventilation is effected by a heat exchanger, and an electric fan which should prove useful in tropical regions as it can also be operated whilst the aeroplane is on the ground.

With the exception of the first prototype, the "Ambassador" is to be pressurised. The pressurisation system is being developed in conjunction with Normalair Ltd., a British firm which specialises in this field.

Another commendable feature of this aircraft is the simple manner in which the cockpit equipment is arranged. Included in addition to the absolutely essential instruments are such devices as fuel flow meters and torque meters, as well as a system of electric light indicators, such as the "take-off readiness" signal which shows when all controls are correctly set, doors closed, etc. There is a blind-flying panel for each pilot, and the aircraft is fitted with a Smith Mark IX gyropilot.

Power plant.

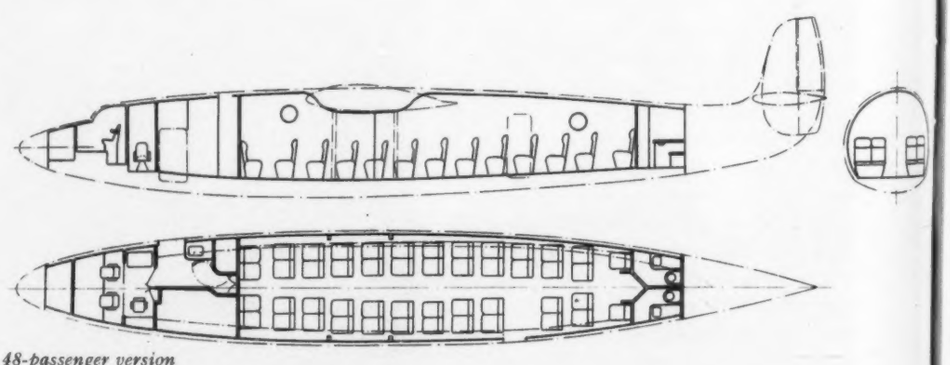
Each of the two nacelles houses a 2,580-H.P. Bristol "Centaurus 631" air-cooled twin-row radial, forming a completely detachable unit together with the oil container and cooler, accessories, mounting rings, cowling, etc. Attachment by four self-locking bolts, quickly-actuated connections for the fuel-feed and pressure-gauge lines and the throttle control, as well as a grouping of the plug and socket electrical contacts, make it possible to detach the power plants in a simple manner, without loss of time. The reversible-pitch airscrews permit the aircraft to be stopped in good time, even in the eventuality of total failure of the wheel brakes.

In their designing of the power plant installation, the constructors have striven to keep the nacelles free of protuberances of any kind. The supercharger air intakes, oil cooler, etc., are internally arranged, while the exhaust and cooling air outlets lie flush with the cowling surface ; cooling and supercharger air are taken in between the airscrew and the cowling by medium of a fan on the airscrew shaft.

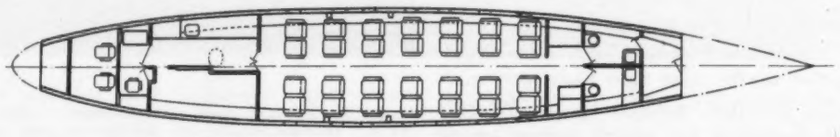
The generator and—in the pressurised version—the cabin blower are coupled to the engines. Thus, neither the hydraulic pressure nor the air pressure systems are engine-driven, but, as previously stated, have their own independent electric pumps.

Performance.

The gross weight of the first prototype is 47,000 lbs ; equipped to seat forty passengers and with the preliminary condition of a cruising output amounting to 60 per cent of the rated power, it can cope with a range of 825 miles at a cruising speed of 250 m.p.h. at 10,000 ft. altitude. With the help of water injection, the take-off power of the "Centaurus" engines will doubtlessly be stepped up soon from 2,580 H.P. to more than 3,000 H.P. With this, the all-up weight would be increased to 49,500 lbs., which circumstance,



48-passenger version



28-passenger version

under the above quoted conditions, would bring the range up to 1,225 miles. Provided the engine power can really be stepped up in this way, the airframe will be developed to permit an increased all-up weight of 52,500 lbs., so that the range would then amount to 1,725 miles. Should propeller-turbines ultimately be fitted, the cruising speed could then be increased to 296 m.p.h. at 20,000 ft., though range would suffer in consequence.

In conclusion, it is worth while to draw attention to the rates of climb on one engine, which, it will be realised, are also characteristic of the flight safety of an aeroplane. The 47,000-lb. version, with landing gear retracted, has a rate of climb on one engine of 510 ft./min.; ICAO requirements stipulate 380 ft./min. At 5,000 ft. the rate of climb is 310 ft./min. on full rich mixture, against the ICAO requirement of 200 ft./min.

F. P.

Weight and Dimensions of the "Ambassador."

The typical weight allocation in the standard 40-passenger version :

	lbs.	lbs.
Airframe	15,980	
Power plant	10,060	
Fuel, oil and ancillary systems	720	
Power services	1,000	
Safety measures	650	
Equipment	1,890	
Furnishings	2,600	
Empty weight		32,900
Fuel	3,300	
Oil	235	
		3,535
Crew (3 and steward)	655	
Crew's equipment	50	
		705
40 passengers (170 lbs. each)	6,800	
Passengers' luggage (35 lbs. each)	1,400	
Freight or additional luggage to fill capacity at 10 lb./cu.ft.	1,500	
Food and drink (4 lb./passenger)	160	9,860
Gross Weight		47,000
Wing loading (at 47,000 lbs.)	39.2 lb./sq.ft.	
Span loading	3.55 lb./sq.ft.	
Power loading at take-off	8.75 lb./H.P.	
Span	115 ft.	
Overall length	80.25 ft.	
Height over fin	18.8 ft.	
Wing area	1,200 sq.ft.	

Cabin (40 passengers)

Maximum width	10 ft. 6 in.
Height under wing	6 ft. 4½ in
Length	32 ft. 5 in.

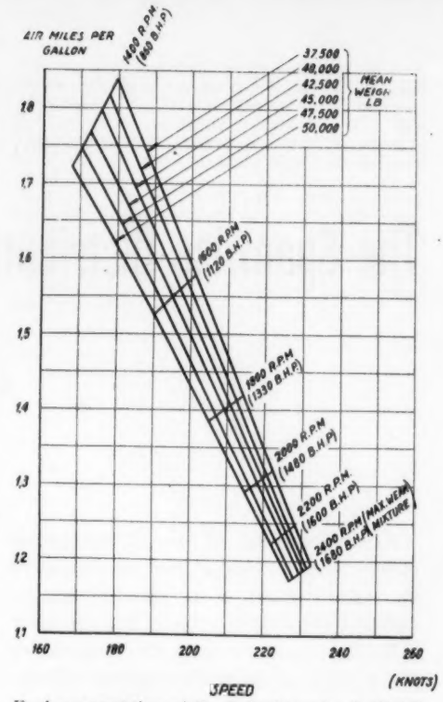
Compartments

Luggage and freight (40-passenger version).

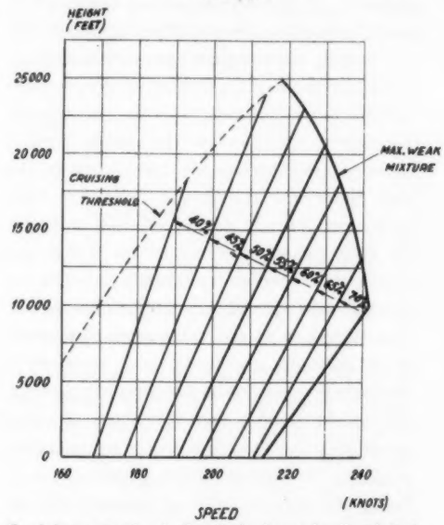
Nose compartment volume	15 cu. ft.
Forward main compartment volume	190 cu. ft.
Forward main compartment floor area	22 sq. ft.
Rear freight compartment volume	100 cu. ft.
Rear freight compartment floor area	20 sq. ft.

Toilets

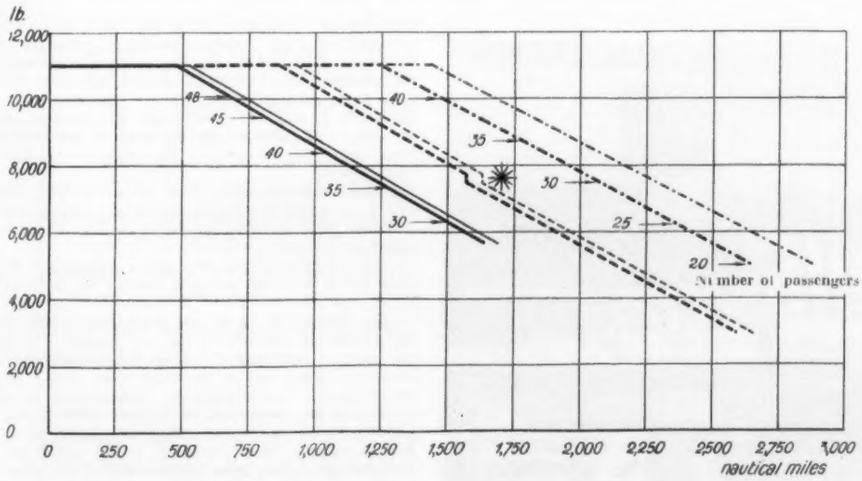
Two compartments, each with floor area	17 sq. ft.



Fuel consumption of the " Ambassador " plotted against cruising speed for different gross weights, at 5,000 ft.



Cruising speed of the " Ambassador " plotted against altitude for different engine outputs, expressed in percentage of the maximum continuous output (1,680 H. P.)



Range of the " Ambassador " in still air, plotted against payload

Full lines : Version for 48 passengers at 47,000 lbs. gross weight and cruising at 5,000 ft. and 215 m.p.h. (185 knots)

Dash lines : Same as above, but at 49,500 lbs. gross weight

Dot-dash lines : Pressurised version for 40 passengers at 52,500 lbs. and cruising at 20,000 ft. and 240 m.p.h. (210 knots)

Heavy lines represent range with safety fuel reserve prescribed by BOAC

Light lines, extreme range without safety fuel reserve

* *Payload decrease due to installation of two auxiliary 300-Imp. gal. fuel tanks in wing centre section.*

The Spanwise Distribution of Lift on Aircraft Wings

By J. PIERRAT, ingénieur en chef de l'Air, Paris.

Exact knowledge of the lift distribution along a wing is essential both for calculating the static strength of the structure and for assessing the aircraft's flying characteristics.

Modern, improved methods of calculating the strength of materials, together with the progress made in extensometrical measurement, enable the strains in a structure subjected to given exterior forces to be determined precisely. On the other hand, the bid for higher performance aircraft entails a maximum permissible limitation of structural weights and, consequently, of the corresponding safety factors: in the latest French strength specifications for heavy aircraft, the load factor for the elastic limit has been reduced to 2.5. It is evident that, in flight, the accelerations will not be far below this value; it is therefore no longer possible, as has not unfrequently been the case in the past, to reckon on an overmeasure of security in the strength specifications as a means to camouflage errors in the determination of the exterior forces in a case for which the data are given: these exterior forces must correspond to the actual forces which occur in flight, and with a degree of accuracy as high as modern methods of extensometrical measurement permit; a degree of accuracy of the order of 5 per cent is usually demanded.

The earlier method of schematically setting the wing loading according to the chord is therefore no longer able to fulfil modern requirements.

In all countries ever more importance is being attached to the behaviour until the stalling point of aircraft with large angles of incidence. The stalling speed could be defined as the flying speed at which a pitching movement of large amplitude occurs, which can simultaneously be accompanied by a rolling of the aircraft. If the speed is attained by progressive setting of the elevator, these movements cannot be controlled immediately by the pilot. For safety it is considered essential that the angle of roll should not exceed a certain maximum; according to French regulations this angle is in principle fixed at 20 degrees for public transport aircraft. The simplest way of keeping to this rule is to have the flow break down at the wing centre section before the wing tips. In this way the stall progresses symmetrically, and the ailerons retain their efficacy throughout the entire procedure.

It would be superfluous, however, to insist further on the extreme importance of precise knowledge of the lift distribution, for this is ignored by nobody today.

Prandtl's theory leads to the classical integral equation:

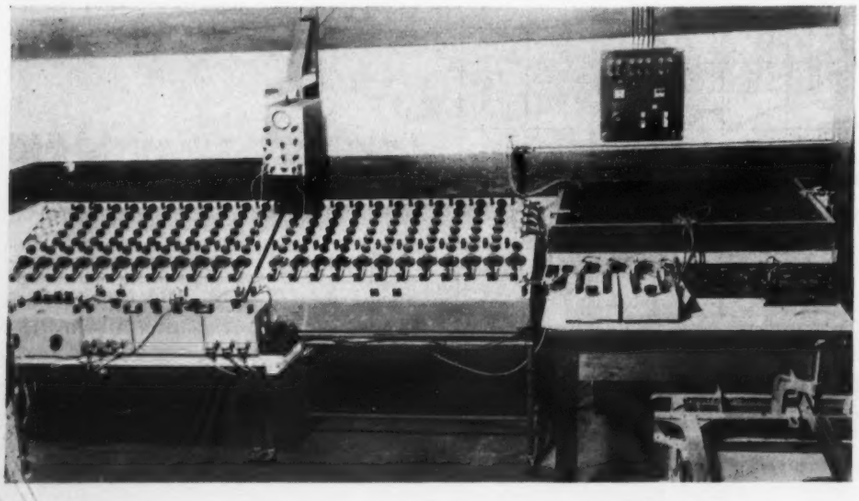
$$\frac{\Gamma(x)}{K v t} = \alpha - \frac{1}{4 \pi v} \int_{-b}^{+b} \frac{d\,\Gamma(\xi)}{x - \xi}$$

the solution of which gives the function $\Gamma(x)$, and hence the circulation around each wing section, from which the lift may be deduced directly. In this formula, K = profile coefficient, t = wing chord, v = speed of flow, and α angle between v and the chord of the aerofoil. This formula serves as a basis for valuable mathematical and physical studies.

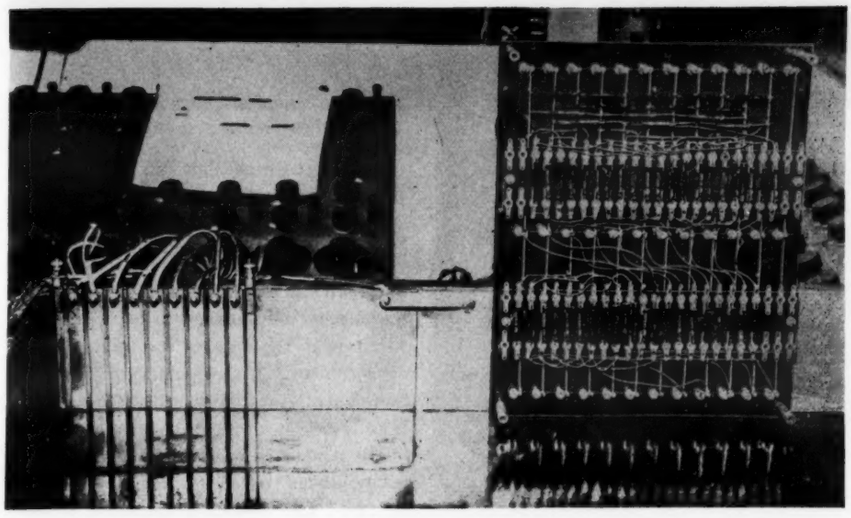
The purely mathematical methods (Lotz-Multhopp) are little used in France; preference is given to the elegant method of electrical analogy conceived by Peres and Malavard. [1]

The principle of this method is briefly the following: the spanwise circulation is determined by measuring a plane electrical potential, in a water tank, which is produced by a series of electrodes replacing the wing sections; the initial potentials of the electrodes are adjusted, by means of resistances, to correspond to the wing data.

[1] "Etude de quelques problèmes techniques de la théorie des ailes." By Lucien Malavard (Blondel la Rougerie, Paris, 1939).



General view of the "wing-calculating" apparatus. To the left of the photo: the electrical switch panel for adjusting the values in accordance with the wing to be calculated.
Each row of switches corresponds to a section of the wing (22 sections for the half or the entire span, according to whether the wing is symmetrical or not).
One row comprises:
(1) Five stages of gauged resistances which can be adjusted to a value proportional to the product $k \cdot t$.
(2) One potentiometer allowing a potential to be adjusted to a value proportional to the product $k \cdot t \cdot \alpha$.
To the right of the photo: the water tank in which the picture of the field of the free vortices aft of the wing is represented. It is fed by electrodes arranged along one of the walls (not visible in the photo). Each electrode corresponds to a section of the wing and is coupled with a row of switches on the panel. The measurement *of one electrode's final potential, which represents a resultant value after influence by the other electrodes, directly indicates the circulation around the wing-section concerned.*



View of a corner of the water tank and the electrodes. To the left of the photo: the row of small plate-electrodes visible in the corner of the tank corresponds to one of the wing-halves (the other wing-half is not necessary, in view of the reflection effect by the wall at right-angles to the row of electrodes.)
To the right of the photo: for conventional wing calculations, for which the abscissae of the wing-section can be fixed from the start, the water tank can be replaced *with a system of electrical resistances which can be adjusted once and for all; a system of this kind is represented by the panel visible to the right of the photo.*

This extremely prolific method enables tables to be established which embrace practically all possible plane forms, and aspect ratios between 4 and 18. Reduced to rules of three and additions, the calculations do not require a specialised personnel.

Meanwhile, it should not be forgotten that Prandtl had to make a series of hypotheses in the establishment of his formula. It would be wrong to demand of a mathematic formula more than it can offer; after the execution of a long calculation, one should keep in mind those restrictive assumptions which were accepted in order to simplify the procedure.

The present case involves the following restrictions :—

a) The formula is established for incompressible flows; it ceases to be valid at high Mach Numbers and is only applicable up to Ma = 0.7.

b) The formula supposes that the span is large in proportion to the chord; it cannot be used for very low aspect ratios.

c) The formula does not take sweepback into account; it is no longer valid for sweepbacks in excess of 20 degrees, for which the lateral component of the flow must be taken into account.

d) The formula does not take the fuselage and engine-nacelle influences into account; to do so is at the penalty of supplementary hypotheses which are often uncertain.

e) The formula entirely neglects the elastic deformation of the wing.

f) Finally, the formula is only valid for the rectilinear part of the curve of the lift plotted against the angle of incidence for infinite spans.

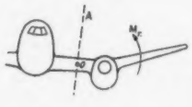
In this connection, it may be mentioned that Peres and Malavard succeeded, by progressive approximation, in also applying the method of electrical analogy to the curvilinear section of the curve, so that the basic calculation of the lift distribution at stalling angles is possible.

Thus, in view of the above restrictions, Prandtl's theory no longer suffices in the majority of cases for solving the practical problems which today confront the designers of modern, high-speed aircraft.

It is intended in France to use the experience gained in other methods, the principles of which are briefly as follows :-

(1) *Wind Tunnel Tests.*

The aim is to determine the moment of the aerodynamic forces around an axis. The outer wing is articulated to the model, whereby O represents the axis of rotation.



At a given angle of incidence the torsional moment M_{To} around O is measured for a freely chosen wind speed v. The result is the bending moment coefficient :

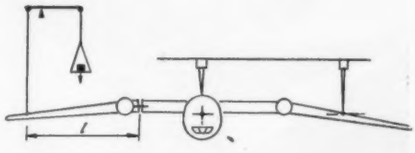
$$c_{mF} = \frac{M_{To}}{\frac{1}{2}\ \varrho v^2\ V_m}$$

If V_m is the model's volume of reference, and V_a the corresponding volume of the actual aeroplane, the bending moment for the actual aeroplane is

$$M = c_{mF} \cdot \tfrac{1}{2}\ \varrho\ v^2\ V_a$$

The model is divided in the plane A; the axis O, which must be without friction, is materialised by fully submerged articulations.

In order to obtain the bending moment due solely to the lift forces, the axis O must be parallel to the direction of flow.



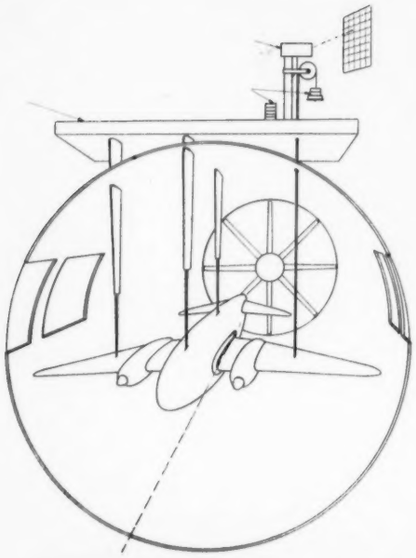
The articulated portion of the wing is connected by a wire to a dynamometer.

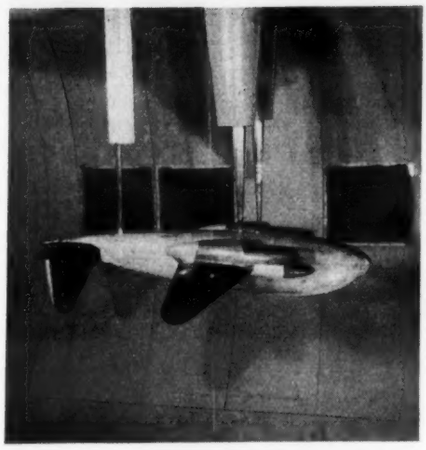
It could prove advantageous if the model were examined in inverted position, with the inherent weight of the wing and the aerodynamic loading acting in the same direction. In this case only one wire is necessary on the wing lower surface; this causes no noticeable disturbance and it leaves the suction side of the wing uninfluenced.

Thanks to this arrangement, it is possible to determine the bending moment about any axis along the wing in a purely experimental manner. For various small twin-engined aircraft, for which the fuselage and engine nacelles could not be ignored, the results obtained by measurement were compared with those obtained by calculation.

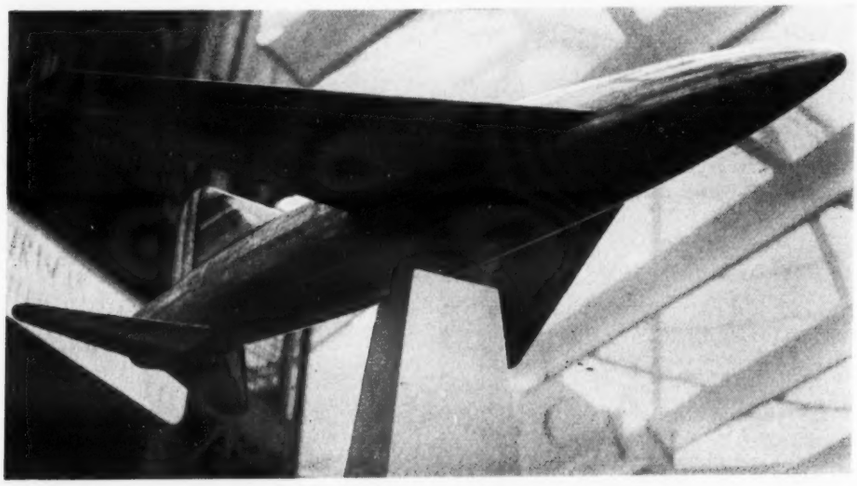
The theoretical calculation of the load distribution was carried out under the condition that Prandtl's theory, which assumes the wing to be a supporting line, was valid. Consequently, the fuselage and engine nacelles were replaced by imaginary wing sections, the characteristics of which had to be determined for infinite aspect ratio and setting.

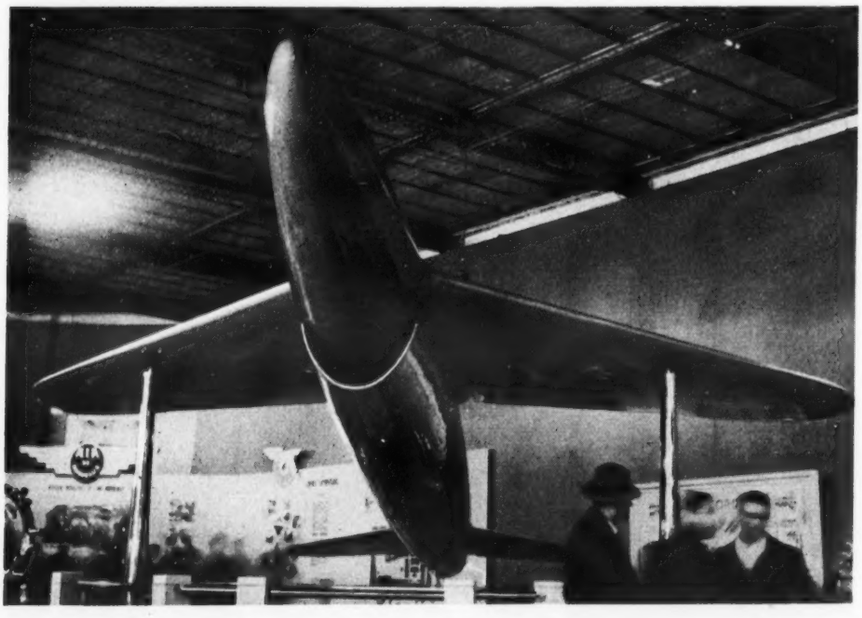
The lift curve plotted against the angle of incidence was established for :





Suspension of the model in the wind tunnel.





(1) wing alone,

(2) wing with nacelles,

(3) wing without nacelles, with fuselage (without horizontal empennage),

(4) wing with nacelles and fuselage (without horizontal empennage).

Tests (1) and (2), and (1) and (3), enabled the chord and setting of the profiles replacing the nacelles and fuselage to be deduced (by variation of the slope of the lift curves and displacement of the points of zero lift). Subsequently, test (4) justified these assumptions.

The models to which the wings were articulated were tested for configurations (1) to (4). The moments measured as aerodynamic loadings at the wing root exceeded those obtained by calculation. The difference for the smallest aeroplane amounted to 9 per cent, and to 5 per cent for a slightly larger type.

(2) *Flight Tests.*

For the time being, there are no high-speed wind tunnels in France ; the measuring method dealt with above cannot, therefore, be used for the high-speed aircraft at present in development. For these, there was no choice but to build flying models for the flight tests, for which the pressure distribution can be measured over four wing sections along the span. As a great number —in this case 96—of different pressure measurements had to be executed within a very short space of time, flight tests of this nature met with considerable practicable difficulties. The measurements are to be registered by means of the HUSSENOT-BAUDOUIN multiple recording apparatus.

In conclusion, it may be mentioned that an experimental transsonic aircraft, at present under development, will be equipped with a six-component recording device for wing forces and wing moments. This device will make it possible to obtain—though nevertheless in integral form only—valuable information on the lift distribution during the piercing of the sonic barrier.

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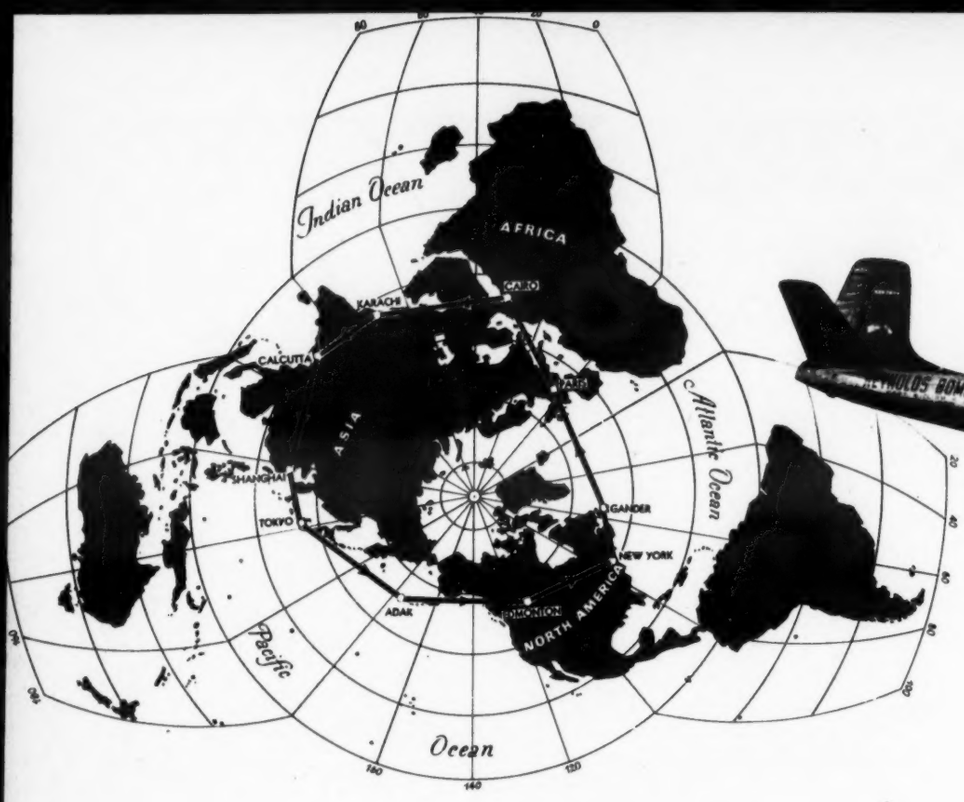


The "Reynolds Bombshell," a converted Army surplus Douglas A-26B attack bomber, makes a test-flight before the start of the trip.

Mr. Reynolds Flies Around The World

Justice G. A. Urquhart sat patiently in his Chair at Assizes Court, Toronto, on April 14th. He was waiting to preside over a breach of contract suit.

"Where is the defendant ?" he asked.

Counsel replied : "He left Calcutta at 4 : 30 a. m. today, on his way to Shanghai, Tokyo and Alaska."

"Will he be back tomorrow ?" demanded Justice Urquhart.

"I don't know," Counsel said.

The defendant was Milton Reynolds, Chicago fountain pen king, who was then flying around the world in record time. He nearly succeeded in arriving back at his starting point "tomorrow" : at 0 : 06 hrs. on April 16th his aircraft landed in New York, after circling the globe in 78 hours 55 minutes 30 seconds.

* * *

Voyages around the world have fired the imagination of man ever since he found the world was round. Colombus attempted to find a shorter route to India "the other way round" and discovered America instead. Magellan, the Portuguese, sailed around the world in three years from 1519 to 1522. In 1873 Jules Verne's fictitious Phileas Fogg made an equally fictitious voyage around the world in eighty days.

The first successful trip around the globe by aircraft, accomplished by a group of U. S. Army aeroplanes, in 1924, was a stepdown compared with Phileas Fogg's performance, as it lasted 175 days ; in fairness it must be added, however, that only a little more than 14 days were spent flying. — There followed several similar flights in the twenties, including one by a British formation, another by an Italian group under de Pinedo, and yet another was made in 1929 by Dr. Eckener, the German airship pioneer, aboard his dirigible "Graf Zeppelin."

The real round-the-world-record fever broke out in the thirties. In 1931 Wiley Post and Harold Gatty piloted their "Winnie Mae" along a 15,474-mile northern course in 8 days 15 hours 51 minutes. Two years later, Wiley Post repeated the feat alone in 7 days 18 hours 49 ½ minutes. And in 1938 Howard Hughes, the millionaire sportsman-pilot, astounded the world by flying around it in 3 days 19 hours 14 minutes 10 seconds. Though several flights were made by military transport aircraft during and after the war, it is Howard Hughes' record—which, like the latest performance, is not officially recognized by the Fédération Aéronautique Internationale—that Milton Reynolds broke in the time from April 12th to 16th, 1947.

* * *

The purpose of the Reynolds flight is only too obvious. Though Milton Reynolds is a fervent aviation fan and a private pilot himself, he did not make the trip out of pure enthusiasm. Upon completing his global dash, he confessed that he "wouldn't make the trip again for a hundred million dollars" (which *might* be an exaggeration !) and that he was "scared to death most of the time." The flight actually was a classical example of American high-pressure advertising : Mr. Reynolds' business is the manufacture and

A crowd had assembled at La Guardia Field, New York, to welcome the fliers after their record-breaking round-the-world flight of 78 hours 55 minutes.

sale of pens, whose prestige, incidentally, is reported to be in need of a little boosting.

There is no doubt, however, that the feat gives credit to the quality and endurance of the flying equipment and crew, as well as to the efficiency of the American commercial and military servicing and repair crews along the route.

The aeroplane used for the flight was the "Reynolds Bombshell," a Douglas "Invader" twin-engined surplus attack bomber of the U. S. A. A. F., formerly the A-26B-65-DO, powered by Pratt & Whitney R-2800-79 eighteen-cylinder twin-row radial engines of 2,000 H. P. each. The wing span of the A-26 is 70 ft., the length 50 ft. 9 in. ; normal loaded weight of the military type amounts to 27,000 lbs., maximum overloaded weight to 32,000 lbs. ; maximum speed of the heavy military type is 345 m. p. h. at 5,000 ft., but the lighter record machine, with slightly modified engines, had a better performance at greater heights. — The record aircraft was modified by the removal of gun turrets and about 8,000 lbs. of armour and by the installation of extra fuel tanks ; the latter brought the total fuel capacity to 2,400 U. S. gallons.

Captain William P. Odom was the pilot throughout the flight and shouldered the heaviest burden of the adventure ; he hails from Roslyn, on Long Island, N. Y., and had previously logged more than 6,000 hours in the air. His experience as a ferry pilot flying American bombers across the Atlantic to Britain during the war and his prewar experience as a commercial pilot flying between India and China stood him in good stead. It was Odom who established the flight plans, piloted the aircraft and shared in navigating it, practically without sleep for the duration of the entire trip.

The remaining crew members were Milton Reynolds, who acted as navigator, and T. Carroll Sallee, of Dallas, Texas, the flight engineer.

* * *

The entire project does not seem to have been prepared with the thoroughness Howard Hughes devoted to his own flight in 1938. The latter was accomplished with a brand-new, specially-built and -equipped Lockheed 14 and carried, apart from Hughes as the pilot, a copilot-navigator, another navigator, a radio engineer and a flight engineer. The success of the latest flight would therefore seem to have been due in a large measure to the improved military and commercial airport facilities that have become available during and since the war.

It was not until March 17th that Reynolds decided to attempt the flight and signed the contracts for the employment of the crew and the purchase of the aircraft. Even as late as that, Reynolds attributed no aims of aeronautical achievement to the flight : "I want to set a new round-the-world record—other people collect stamps and some collect buttons."

It is quite likely that the hastiness of these preparations, in addition to bad weather encountered en route, was to blame for the fact that the flight was not completed in 55 hours as originally planned. In Paris the machine was held up by radio trouble and refuelling difficulties, in Cairo repairs had to be carried out on a faulty nose-wheel and again on the wireless equipment, the oxygen supply ran short on parts of the way, and on the last leg of the trip one of the engines gave some trouble.

* * *

The "Reynolds Bombshell" (cf. map) followed a 20,020-mile course from La Guardia Field, New York, to Gander (New Foundland), Paris, Cairo, Karachi, Calcutta, Shanghai, Tokyo, Adak (Aleutians), Edmonton (Canada) and New York. The original plan was to fly along the route followed by Howard Hughes in 1938, namely, from New York to Paris, Moscow, Omsk, Yakutsk, Fairbanks (Alaska), Minneapolis and New York, a distance of 14,824 miles. However, the Russians did not grant the requested landing permits, and, as a result, the other route—5,200 miles longer—was finally used. Two last-minute modifications had to be incorporated also in the second route : at La Guardia Field permission was refused for the machine to take off with a full fuel load, and the projected New York—Paris leg had to be changed to include a stop at Gander. Furthermore, the Reynolds crew first planned to fly from Tokyo straight to Anchorage, Alaska, and thence to New York, but bad weather was encountered over the North Pacific. The "Bombshell" then landed at Adak, in the Aleutians, flew straight to another improvised stop at Edmonton, Canada, and then to New York.

The flight started in the afternoon of April 12th and was accomplished without serious incident, apart from the minor mechanical difficulties which delayed the aircraft unduly at Cairo, Calcutta, Tokyo, Adak and Edmonton. The meteorological service was found to be very unsatisfactory for the hazardous flight across the Himalaya from Calcutta to Shanghai, whilst the worst weather was actually encountered on the two last stages from Adak to Edmonton and New York. Altitudes between 19,000 ft. and 23,000 ft. were maintained practically throughout, and all three men took oxygen nearly all the way.

The record trip was accomplished in a total of 78 hours 55 minutes 36 seconds, which clipped 12 hours 18 minutes and 40 seconds off the time taken by Howard Hughes in 1938. Since 16 hours 13 minutes was spent on the ground, flying time of the Reynolds flight appears to have been 62 hours 42 minutes, though Captain Odom himself claimed 55 hours 46 minutes. Hence, the round-the-world trip was accomplished at an average speed, including time at intermediary stops, of about 254 m. p. h., whilst the average speed based on flying time was 319 m. p. h. or, on the basis of Captain Odom's indication, approximately 359 m.p.h., a figure, even assuming favourable winds all the way (which was not the case), that would seem extraordinarily high for the type of aircraft employed.

The first thing that befell the three men upon their arrival in New York was a smallpox vaccination and a hero's welcome at La Guardia Field. On the day of their return they flew to Washington, Chicago and back to New York. On the 17th they were back in Washington, to be congratulated personally by President Truman.

Another round-the-world flight successfully accomplished : what next ? A dash around the globe in a jet-propelled aeroplane, or a flight along the equator ?

P. A. B.

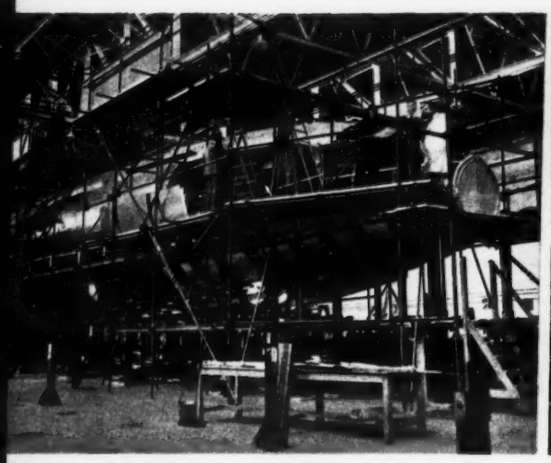
Back home : "Tex" Sallee, flight engineer : Milton Reynolds, sponsor and navigator (plus lucky doll and Reynolds pens) ; and William P. Odom, pilot, who was chiefly responsible for the success of the flight.

FLYING STAGES AND FLYING TIMES

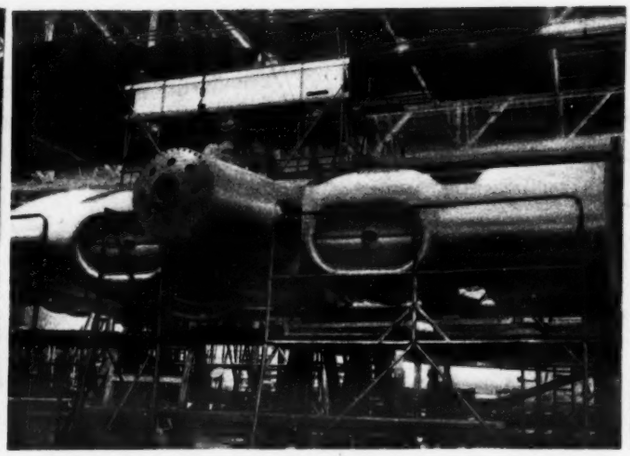
(New York times, E. S. T.)

Date	Stage	Take-off	Landing	Flying Time	Distance (miles)	Total covered (miles)
April 12	New York—Gander	17 : 11	20 : 11	3 : 0	1160	1160
" 12/13	Gander—Paris	21 : 51	04 : 51	7 : 0	2630	3790
" 13	Paris—Cairo	06 : 13	12 : 51	6 : 38	2150	5940
" 13/14	Cairo—Karachi	15 : 12	22 : 02	6 : 50	2260	8200
" 14	Karachi—Calcutta	22 : 56	03 : 05	4 : 09	1400	9600
" 14	Calcutta—Shanghai	05 : 03	11 : 58	6 : 55	2150	11750
" 14	Shanghai—Tokyo	13 : 22	16 : 58	3 : 36	1100	12850
" 14/15	Tokyo—Adak	19 : 24	04 : 25	9 : 01	2500	15350
" 15	Adak—Edmonton	07 : 24	15 : 55	8 : 31	2650	18000
" 15/16	Edmonton—New York	17 : 04	00 : 06	7 : 02	2020	20020

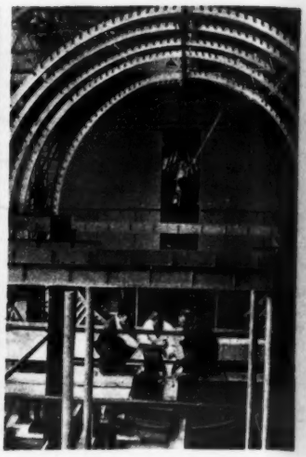
England's Bid to Catch Up



The fuselage on the assembly scaffold.



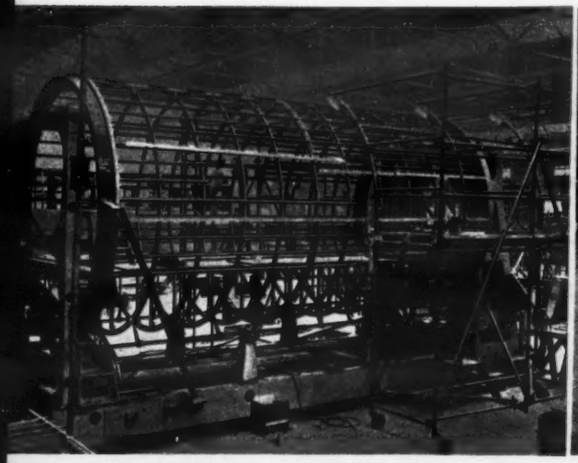
Each pair of gas-turbine engines, fully submerged in the wing, drive a common airscrew shaft. (Instead of gas-turbines, the prototype is fitted with pairs of Bristol "Centaurus" air-cooled twin-row radials.)



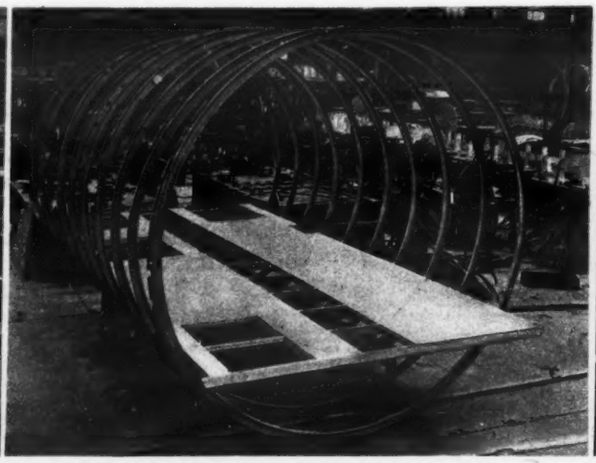
Fuselage centre section.

As regards the manufacture of long-range, heavy transport aircraft, America is undisputably the leader. Ever since the end of 1944, it has been the aim of the British aircraft manufacturers to catch up on her lead. Two main projects are under development: the *Avro* "*Tudor II*," a four-engined airliner of 34 tons all-up weight, capable of accommodating 60 passengers, is already being flight-tested; and the largest British type, the *Bristol* "*Brabazon I*," an eight-engined airliner of over 120 tons, is approaching completion. The British manufacturers were to discover that the American advance was greater than they had at first supposed. Whilst the trials of the "Tudor II" could not be concluded satisfactorily, and revealed the necessity for various changes in the production plans, Bristol's are encountering considerable difficulties with the "Brabazon I" and are having to defend themselves against many sharp criticisms. The prototype is several months behind schedule, and it seems that the designers' estimates of the weight distribution and payload have been far too optimistic. At all events, the company is considerably more cautious now in its data on the "Brabazon I," than beforehand—much to the disappointment of British civil aviation, which has been eagerly awaiting this new airliner.

Herewith a few photographs showing the two aircraft in their various constructional stages.



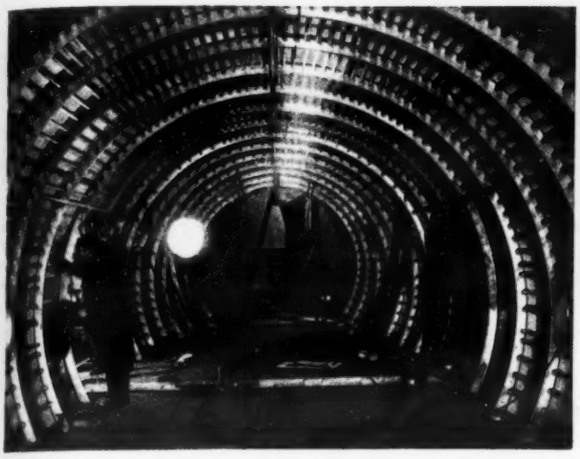
Fuselage skeleton on the assembly scaffold.



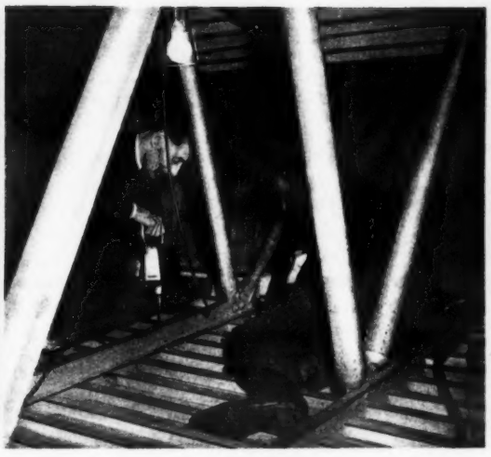
Circular frames with cabin floor.

Control rods beneath the floor.

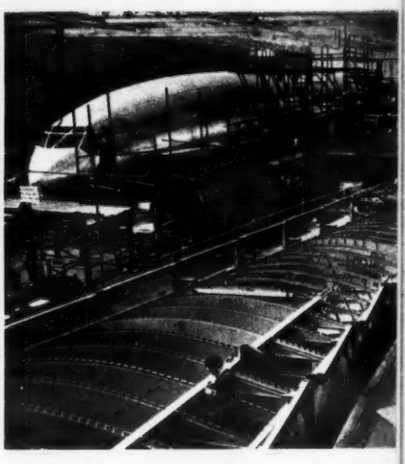
Brabazon I



Main cabin prior to application of the skin.

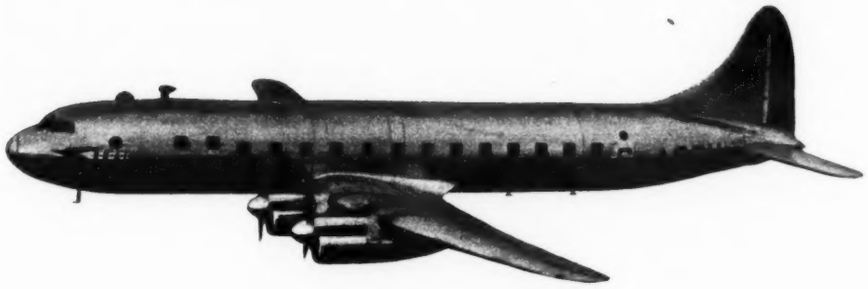


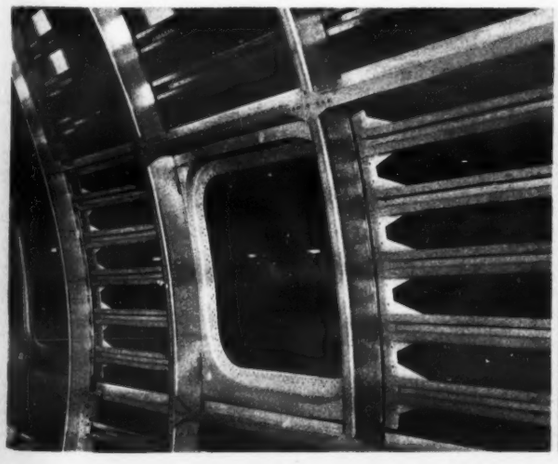
Frame-work ribs.



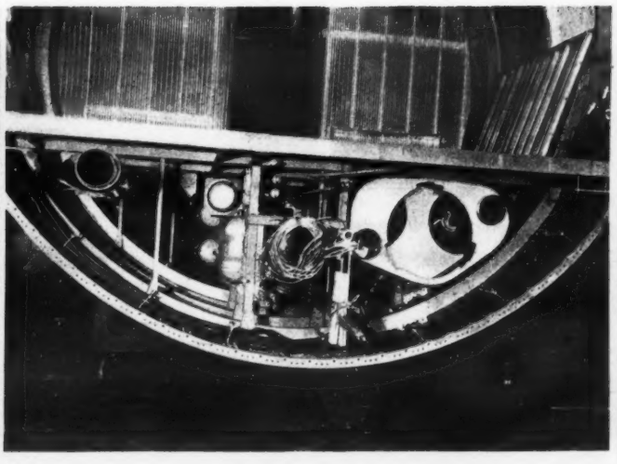
Outer wing on the assembly scaffold.

Tudor II

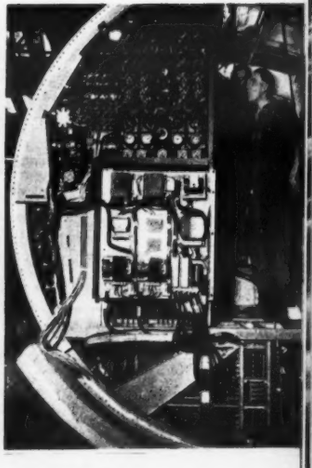




Window frames.



Auxiliary equipment and ventilation system (right).



Electrical leads to the flight engineer's instrument pane.

The "Grandfather Clauses" in Aviation

BY DR. WERNER GALLESKI

The resemblance, in spite of the difference of occasion and effect, between the judgement in American traffic matters right now and a hundred years ago, is astounding. As in Abraham Lincoln's time of stage coaches, veteran railways and steamships, we still find many decisions based on so-called "grandfather clauses," which are not a bit antiquated, despite their name, and still guide administrative thinking when conflicting interests of air companies have to be adjudicated.

A grandfather clause, in the proper sense of the word, referred originally to the constitutional prerequisites of voting in several Southern States. Any man whose ancestors had voted in the State concerned before 1867, is still automatically entitled to the vote without having to undergo the very cumbersome tests as to a minimum property and literacy.

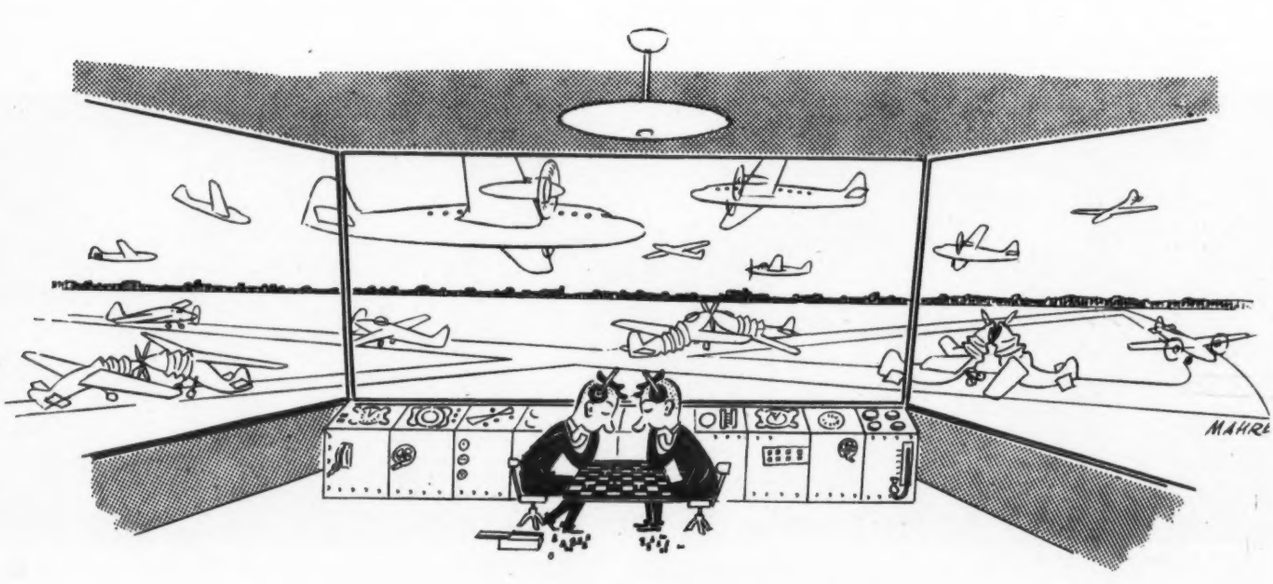
Beyond that special application, grandfather clauses are symbolical institutions expressing the view that if a person has run some kind of business for a long time, this person has gained vested rights and must be given preference over newcomers in the same trade. Short as the history of the United States might be, or just for that reason, Americans are proud of this principle derived from the old days, and will incessantly confirm it. So they are bound to uphold the same patina-covered principle in matters of flying. If one carrier has held a licence for many years, and another company wants to exploit the same lucrative routes, the sublime legislators and courts of many States will at once resort to the ingrained custom of the grandfather clauses, and rule in accordance.

But the legal divergencies of forty-eight States, which frequently lead to different practices even in neighbouring territories, leave sufficient room for varying and confusing decisions. For instance, the area of the State of Kentucky knew no restrictions to competitive flying until June 13th, 1944. Planes operating strictly within the "Commonwealth of Kentucky" could bustle about without licence, and companies indulged in competition as much as they liked. If they transgressed beyond the Kentuckian orbit, they flew right into federal jurisdiction. For under the constitution of the U. S. A., the Central Government in Washington watches over all matters of inter-State commerce, whereas the single States jealously guarded their rights of mastering their domestic traffic and trade. Up to this date, certain States have failed to curtail any movement in the air. The worthy Commonwealth of Kentucky, however, fully aware of tradition and grandfather clauses, deviated from the *laissez faire* viewpoint. The Kentucky Aeronautic Commission was instructed to leave all established "grandfather" companies in undisturbed possession of their flying privileges exercised on June 13th, 1944, and demand only in the cases of newcomers a proof of the "public convenience and necessity" of their air service.

In October, 1946, the Court of Appeals of Kentucky pronounced a decision in the case of Commonwealth Air Transport, Inc., versus Stuart Brothers, owners of Blue Grass Air Lines. The romantic Blue Grass brothers claimed the privilege of the grandfather clause for protection of their rights and dollars. Commonwealth, a much larger and financially stronger firm, also saw the opportunity of accumulating dollars, and started with true American tenacity to oust the Blue aviators. The argument was put forward that the little Blue Grass was entirely incompetent, that its service was not up to the standard of Kentuckian flying and that on the effective date of the grandfather clause, not a single passenger or piece of property was carried by the line.

The two young "grandfathers," the brothers Stuart of Russelville, Ky., did not set up their business before 1943, although one of them had been an active pilot before then. They literally started "from scrap," but within a few months succeeded in building up a going concern. The speed of their career was in keeping with the achievements of the hectic pioneer days. The negative elements, exaggerated competitive spirit and love for elbow tactics, are also in the picture as in days of yore. — The brothers Stuart and their Blue Grass Line did in fact not carry any passengers or goods on the fateful date, as stressed by their opponents. Their whole air fleet was not too impressive, having been started with a single plane, then increased by three more, each of which had hardly space for more than three passengers at a time.

In spite of these insufficiencies, the court ruled in favour of Blue Grass. The judges took into full account the difficulties of an air line in the process of building up a trade, once this trade has been sanctioned by the all-forgiving grandfather clause. The unfortunate Commonwealth line was the newcomer and eyed with misapprehension. Elaborating on the grandfatherdom of Blue Grass, the court said respectfully: "The Blue Grass service was blazing a new trail. It was experimental, for previous to that day people generally had not become accustomed to that mode of travel, especially for relatively short distances. A fairly consistent pattern of operations was shown. The services were not incidental, sporadic or infrequent." — And, with their minds wandering back to the early age of motor traffic, which set the foundations for the great era of aviation, the learned jurist concluded: "Pioneering, in its daring, excuses shortcomings of services. Those who pioneer the way in a new enterprise, have the right to have these grandfather clauses liberally construed to preserve the positions which they have struggled to obtain."



Tailor-Made Aircraft

Beech Model 34.

Empty seats in a passenger plane, whether for the entire trip or only intermediate legs, are a bugbear to any airline operator. They invariably feature in red on the ledger, and can seldom be entirely compensated by increased cargo shipments. On non-stop journeys, once the number of passengers is established, it is possible to realise fully on the plane's load capacity; but short-line traffic, entailing whole series of intermediate stops, is packed with problems. The recommended practice on low-traffic legs is to supplement the payload with freight. In the majority of aircraft, however, the cargo compartments are too small for bulky commodities or low-density freight.

One of the primary conditions of lucrative short-line air transportation is that the intermediate stops be as short as possible. The ideal short-line aircraft, therefore, would be one which enables the size of the passenger cabin to be increased or decreased, simply and quickly, to suit the operator's convenience.

Beech Aircraft Corp., of Wichita, Kansas, has just announced the *Beech Model 34*, with a cargo compartment which can be modified in size to suit the momentary occupation of the passenger cabin. The prototype is expected to take to the air this June. The adjustable cargo compartment is aft of the cockpit, with a moveable wall separating it from the passenger cabin. Of the twenty seats, the six foremost are flap seats along the walls, and can be folded up when not in use and incorporated in the cargo compartment. Within three minutes, one man can effect the entire transformation, including the displacement of the wall. Aluminium stanchions on either side of the gangway provide a means of tying down the goods quickly and securely.

The new plane is equipped with tricycle undercarriage and a tailplane with marked upward dihedral. The manufacturers have so far released no data on its performance.

The six foremost passengers in the Beech Model 34, sitting with their backs to the walls.

View towards the door of the cargo compartment.

Extended cargo compartment with folded-up seats; aluminium stanchions enable cargo to be tied down securely.

The Air Hostess Told Us ...

Let's get together ...

Esmeralda, our favourite air hostess, points out that food played a major rôle in air transportation last month. In England she heard that the "Italians will use a new type of Savoia-Marchetti transport to bring new peas picked in Italy to London." In the U. S. A., United Air Lines has named a new food manager, a Swiss chef named Conrad Kung, apparently because U. A. L.'s patrons are crazy about *fondue* and other cheese dishes. And Trans World Airline has come up with a report that it has introduced a "housewife's dream" on its aircraft, a "pre-cooked, frozen dinner that can be held for days in its original state without the loss of flavour or nutrition."

But American Airlines takes—since food is the topic—the biscuit. If you happen to fly aboard an A. A. "Flagship," you are liable to discover special devices for storing babies' nursing bottles, according to a recent release. According to another, you will find that Miss Joan Wimborough, the company's chief food planner, encourages you to eat the fried chicken American Airlines offers you "the way it tastes best ... with your fingers." This, Miss Wimborough opines, adds "pleasant informality from which long friendships develop."

Esmeralda says these are whacking ideas. Just imagine the forty or fifty passengers of a DC-6 or a "Constellation" gnawing chicken bones in unison, to the accompaniment of weird, gurgling noises emitted by hordes of babies sucking bottles. Imagine lukewarm milk splashing up and down the aisle ; think of clouds of odours from babies' rubber crawlers super-air-conditioning the cabin ; visualise passengers discreetly wiping their grease-dripping hands on the upholstery. Pleasant informality — *tutoyons-nous tous !* Whoopee, let's make flying really 'popular' ...

American Airlines' Chemical Laboratory has promptly realised the dangers and is evolving safety measures. It is developing stain-resistant materials for aircraft interiors. And C. R. Smith, Chairman of the Board, is taking a personal interest : the other day he walked into a directors' luncheon, wearing a tie made of such material, and promptly dunked it into the soup to see if it would resist stain as he had been told.

Love's Labour Lost ... or is it ?

That landing rights cannot always be acquired with a pen was discovered by Milton Reynolds, who last month circled the globe in record time with his Douglas A-26 converted attack bomber, the "Reynolds Bombshell." Mr. Reynolds, Chicago fountain pen king, accompanied his application to the Soviet Embassy in Washington for landing rights in Russia by a round dozen of massive gold fountain pens. The Russians politely declined his request and kept the pens. Love's labour lost ? No, says our favourite hostess.

An optimist ever, Esmeralda hopes the pens are good and still in working order by the time they get to Moscow, so that the Russians can sign all those nice international treaties, pacts and conventions, not forgetting the civil aviation agreement everybody is hoping for.

Less Love and Chewing Gum.

In the years when even hard-pressed businessmen travelled by ship, every passenger was more or less required, by tradition, to fall in love with another passenger on every voyage of more than two hours. In that respect the surface vessel has the aeroplane beaten to a frazzle, chiefly due to the latter's lack of promenade decks, secluded corners, and impossibility of mooning on moon-lit nights. In the long run, therefore, the aircraft will no doubt be found to have a beneficial effect also from a social angle.

On aeroplanes, it seems, the traditional *affaires de cœur* are confined to the members of the air crews, for a round trip between, say, Amsterdam and Karachi should be adequate for that sort of thing, albeit not long enough to change the feelings in question into abhorrence on the return flight. Proof of this contention is the fact that Pilot Hallvard Kjell Vikholt and Hostess Anne Hoelfeldt Lund of SAS, the Scandinavian joint overseas airline, were married at Oslo at the end of March. Another case is that of Elizabeth Bentley-Innes, who six months ago became a hostess aboard an aircraft of another long-range operator, British South American Airways. The pilot on her first flight was Captain Kenneth Loveless, who apparently was, too. About a month ago the two were married, and it is rumoured that Captain Loveless is appropriately considering a change of name by deed-poll.

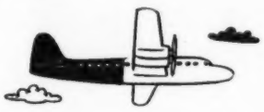
Rounding off her dissertation on Love on the Airlanes, our favourite hostess showed us a report from Mexico City of April 18th. This stipulates that hugs and kisses between local residents and travellers arriving at the Municipal Airport will no longer be tolerated, as it had been found that these expressions of affection were often used to exchange contraband to evade the payment of customs duties. Contraband ? We shrewdly suspect that the chewing gum situation in Mexico City must have been letting up considerably in the weeks preceding the new regulation. Or maybe the artificial-teeth situation.

Know Thyself ?

A Vickers "Viking IB" airliner was demonstrated to local celebrities at Geneva-Cointrin Airport in the middle of last month. The aircraft, quite spacious and comfortably fitted out in a pleasant colour-scheme, has two compartments, the separation being provided by the mid-wing design and the passage of the wing spar through the fuselage.

The two compartments give the aeroplane a cosier atmosphere than that usually encountered in a single, long cabin—and are appreciated, apparently, also from another angle. We heard a very official British per-

sonality, who was riding on one of the demonstration flights, remark to his neighbour : "Ahem. An excellent idea, these two cabins. One for British passengers, the other for Americans to be friendly in . . ." The man really *was* a Briton.



Nothing New Under the Sun.

Trans-Canada Air Lines reports that it recently carried a Sixteenth-Century Persian carpet from Montreal to London. This item is hardly news, for the carpet was not only old, it was antique ; and Flying Carpets have existed in the Middle East, as everybody knows, for hundreds of years before the aeroplane was even invented. There's nothing new in the flying racket.

An English caricaturist recently portrayed one of these Middle-Eastern flying devices fitted with jet propulsion, the latter being provided by a turbaned individual serenely working the handles of a bellows mounted on the stern of the carpet. Not even jet reaction can unbalance a true Faithful.

We think, however, that a flying carpet pressurised for substratosphere jaunts would be news most definitely.

Hystericopters.

Things aeronautical have always excited the minds of men and women to fever pitch, and one of the latest developments in the field firing the imagination of the masses to a point of mild hysteria is, apart from jets and rockets and A-bombs, the helicopter. People, especially Americans, have become helicopter-minded. The helicopter can do anything. The helicopter is the cure of all evils still to be found in aviation. Not later than today or tomorrow, of course.

The helicopter can, these people say, win wars by depositing tough guys in the private room of the enemy's Chief of Staff. The helicopter, they proclaim, will easily win the peace by sowing wheat, by rounding up the cattle herds, by patrolling high-tension power transmission lines, by spotting forest fires, and my murdering millions of locusts before they even know what hit them. The helicopter distributes mail in the suburbs. The helicopter enables rescue parties to rescue parties on glaciers, crop dusters to dust crops, geological experts to find mineral riches, advertisers to advertise.

... Rockettes — Costumettes — Helicopterette...

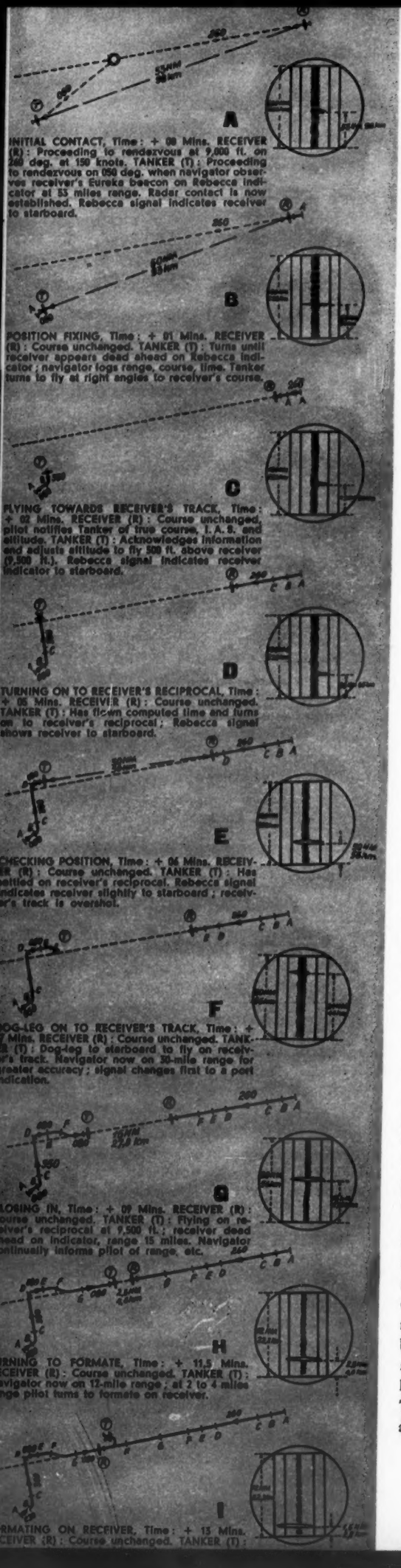
A Californian concern announced some time ago that it was planning to provide helicopter hearses, with the corpse of the beloved defunct riding separately out in front. The laughing heirs would follow behind, devoutly praying not for their benefactor's soul but for themselves, in the ardent hope that they would not join the other chap before the end of the trip. All you want now is a hovering maternity home, a register office for quick take-offs, and a landing square on that place in Reno.

"People who believe that 'a-helicopter-in-every-garage' stuff"—says Esmeralda—"are cracked." We met her on West Fifty-first Street in New York in the last week of March, emerging from the "Showplace of the Nation," the Radio City Music Hall in Rockefeller Center, where she had gone to escape aeronautics for an hour or two. No such hope ! She was a little late getting there, and the first item she saw was a thing called, on the programme, "Wings of Spring." This featured the "first public showing of the Sikorsky S-52 helicopter" which, incidentally, we had seen at the previous first public showing at the Cleveland Aircraft Show last November. Anyway, a trio of dainty chorus girls called Radio City Rockettes, wearing undersized 'aviator' and 'aviatrix' costumettes were pushing the helicopterette around the stage, singing a chansonette entitled "You are in Love" (by Oscar Hammerstein II), probably to the delight of some of the lower characters in the audience.

Our favourite hostess thinks that this sort of stunt indubitably gained the helicopter another two or three fans, whom the demonstration on the stage immediately convinced of the potentialities of rotary-wing aircraft. So, let's buy helicopters. Let's go to town in them and paint it purple. Let's be lifted into and out of our beds and baths by helicopter, sweep chimneys from the inside, harvest raspberries and catch flies by helicopter. And when we're all quite nuts, let's drop out of a helicopterette on to Fifth-Avenette, head first, and hope that this will bring us to our senses. P.A.B.

PS

Our favourite air hostess declares that one should never rely on what men have to say, especially if one does not know a lot about politics and economics and similar things. She confesses that she is deeply horrified at a bit of "gen" she told us last March (No. 3, Vol. II). Under the heading "Scandinavian Brothers" she said that "for all practical purposes the Norwegian DNL and the Danish DDL were State-controlled airlines." This was indeed an error : the Danish Government holds an interest of 20 percent in DDL, the Norwegian Government only 17 percent in DNL. Furthermore, owing to the fact that SAS is formed by three partner companies of different nationalities, no solution has yet been found for the problem of registering the organisation as an incorporated company in the Scandinavian countries. As a result, SAS will continue to operate—according to a remark by the Chairman of the Board of SAS Inc., the SAS agency registered in New York—as "a child of a very beautiful but elusive lady called Consortium Agreement, a very charming mother who has not really been legally married." — Esmeralda, slightly shocked, offers her most abject apologies and says she will endeavour to refrain from commenting upon such questions in future.


A
INITIAL CONTACT. Time: + 00 Mins. RECEIVER (R): Proceeding to rendezvous at 9,000 ft. on 260 deg. at 150 knots. TANKER (T): Proceeding to rendezvous on 050 deg. when navigator observes receiver's Eureka beacon on Rebecca indicator at 55 miles range. Radar contact is now established. Rebecca signal indicates receiver to starboard.
B
POSITION FIXING. Time: + 01 Mins. RECEIVER (R): Course unchanged. TANKER (T): Turns until receiver appears dead ahead on Rebecca indicator; navigator logs range, course, time. Tanker turns to fly at right angles to receiver's course.
C
FLYING TOWARDS RECEIVER'S TRACK. Time: + 02 Mins. RECEIVER (R): Course unchanged, pilot notifies Tanker of true course, I. A. S. and altitude. TANKER (T): Acknowledges information and adjusts altitude to fly 500 ft. above receiver (9,500 ft.). Rebecca signal indicates receiver indicator to starboard.
D
TURNING ON TO RECEIVER'S RECIPROCAL. Time: + 05 Mins. RECEIVER (R): Course unchanged. TANKER (T): Has flown computed time and turns on to receiver's reciprocal; Rebecca signal shows receiver to starboard.
E
CHECKING POSITION. Time: + 06 Mins. RECEIVER (R): Course unchanged. TANKER (T): Has settled on receiver's reciprocal. Rebecca signal indicates receiver slightly to starboard; receiver's track is overshot.
F
DOG-LEG ON TO RECEIVER'S TRACK. Time: + 07 Mins. RECEIVER (R): Course unchanged. TANKER (T): Dog-leg to starboard to fly on receiver's track. Navigator now on 30-mile range for greater accuracy; signal changes first to a port indication.
G
CLOSING IN. Time: + 09 Mins. RECEIVER (R): Course unchanged. TANKER (T): Flying on receiver's reciprocal at 9,500 ft.; receiver dead ahead on indicator, range 15 miles. Navigator continually informs pilot of range, etc.
H
TURNING TO FORMATE. Time: + 11,5 Mins. RECEIVER (R): Course unchanged. TANKER (T): Navigator now on 12-mile range; at 2 to 4 miles range pilot turns to formate on receiver.
I
FORMATING ON RECEIVER. Time: + 13 Mins. RECEIVER (R): Course unchanged. TANKER (T):

Refuelling in Flight

By Sir Alan J. Cobham, London

The exploits of Sir Alan John Cobham, K. B. E., A. F. C., are known to young and old. Born in 1894, this famous British airman has logged many thousands of miles in long-distance flights all over the world, winning numerous trophies and records. He is the pioneer of refuelling in the air, for which he was engaged in experimental and development work from 1936 to 1942. Today, he is Managing Director of Flight Refuelling Ltd., and holds executive positions in a number of British aviation concerns.

The recent news of the forthcoming proving trials of flight-refuelled services, sponsored by the Ministry of Civil Aviation, has aroused interest in the operation of the system. Few people remember the early trials, which I started in England some thirteen years ago, and fewer realise the high standard of attainment which the ensuing years of development have achieved. Most progress has been made in the establishment of contact between the two aircraft, both initially and for refuelling. The application of Radar Rebecca and Eureka units has made possible the establishment of initial contact in any weather conditions—current research may even make refuelling contact possible where weather conditions are too bad to permit visual contact. The Tanker may accompany the airliner to the operational point; but if contact is to be made by interception, the Tanker takes up station at the approximate rendezvous point to await the arrival of the airliner. The aircraft are in constant R/T communication, initially through a ground station and then in direct communication when airborne. When they are between 50 and 80 miles apart, the Tanker can 'home' by Rebecca on the airliner's Eureka beacon. The method of interception from this point is best illustrated by the accompanying diagrams, A to I, which need no amplification. In addition, all Tankers are equipped with radio, compass and manned by expert navigators—in fact, nothing at all is left to chance.

Once visual contact is established, refuelling contact can be made in a matter of minutes, and the method has been proved completely reliable. The whole operation of making contact, passing 1,000 gallons of fuel at a mean rate of 120 gallons per minute, and breaking away, can be accomplished in 15 to 20 minutes. With Lancaster aircraft as Tankers, the process runs briefly as follows. The Tanker formates on the airliner to starboard and slightly below and behind. The airliner operator trails the hauling line, and contact is made by firing a line-carrying 'harpoon' (the projectile) from an accurate line-throwing gun in the Tanker (Fig. 5) into the curve of this line. The projectile is not aimed manually, but the gun is set to a forward firing angle of about 41 degrees, and the Tanker pilot has quite a wide margin for formational position within which the projectile will direct the contact line through the curve of the trailing line. At night, by illuminating the trailing line with a spotlight from the Tanker, it has been found easier to perform this exercise than it is by day, simple though this is.

The contact line on the projectile and the trailing line become engaged and locked upon contact (Fig. 6), and the Tanker operator hauls in the contact line, and attaches the hose nozzle to the hauling line. The hose is then hauled across to the airliner (Figs. 1 and 2), where the cone at the end of the hose locks into a reception coupling in the tail of the airliner (Fig. 7). The Tanker now takes up station slightly above but still to starboard of the airliner, in order to provide the necessary head for the fuel to flow to the airliner by gravity (Fig. 3).

When the required amount of fuel has been passed, the airliner releases the hose coupling (Fig. 4), which permits the hose and the attached hauling line to trail. The hauling line embodies a weak link, and when this is about 50 feet clear of the reception coupling, the Tanker breaks formation by veering to starboard, so tightening the line and breaking the weak link. The Tanker and airliner operators then retrieve and stow equipment, and the two aircraft proceed to their respective destinations.

Although it is in the initial making of contact that the greatest progress has been made, detail improvements in the rest of the equipment have resulted not only in greater reliability but also in making possible the transfer of fuel from one aircraft to another

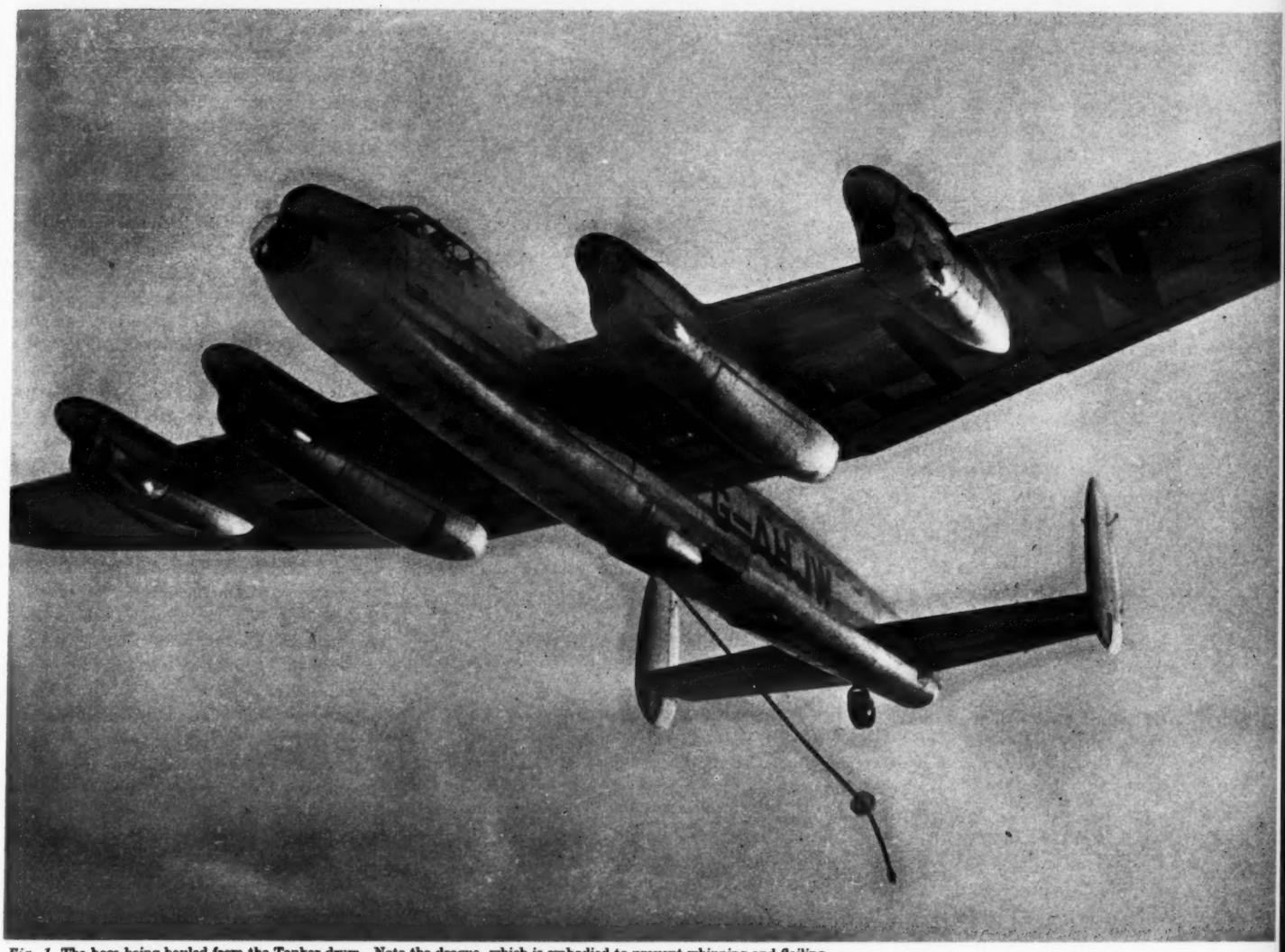


Fig. 1. The hose being hauled from the Tanker drum. Note the drogue, which is embodied to prevent whipping and flailing.
Fig. 2. View of the hose approaching the reception coupling, as seen from the airliner operator's office.

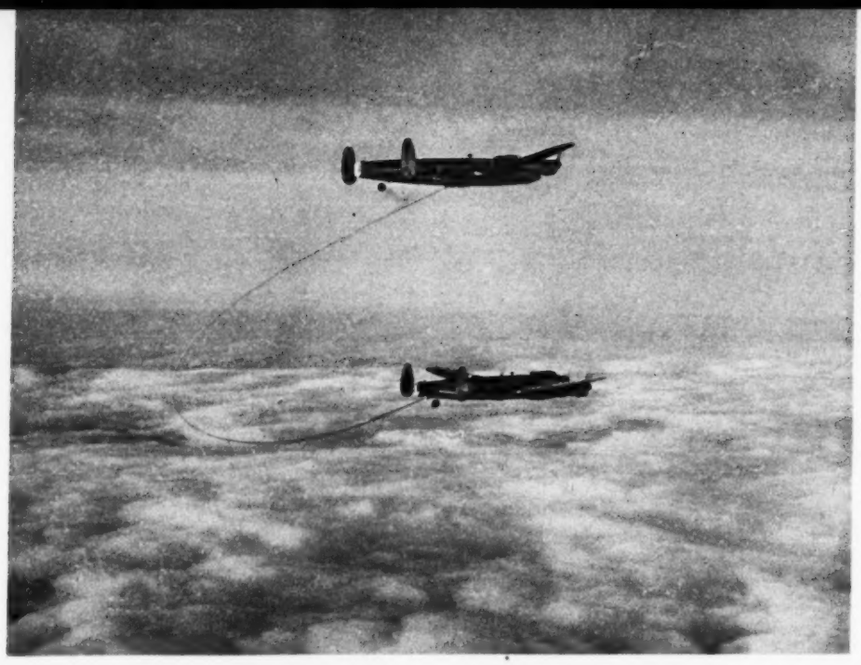


Fig. 3. Tanker and Receiver in refuelling position, with fuel passing.

Fig. 4. The coupling released by the airliner, whose operator is paying out the hauling line from the windlass.

Fig. 5. The projectile in the firing position on the Tanker, showing the contact line stowed in the special honeycomb container.

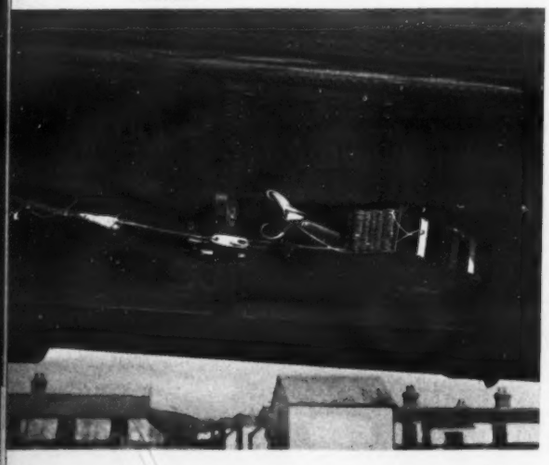
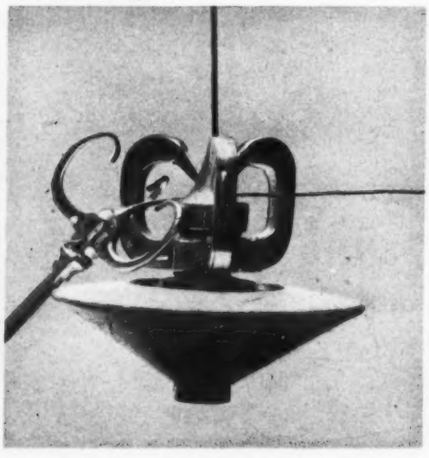


Fig. 6. View showing the projectile and contact line locked in the pawls on the sinker weight attached to the receiver's hauling line.



at much greater flight speeds. With the Avro Lancasters at present in use as Tankers, fuel has been successfully transferred at flight speeds of 200 m. p. h. (I. A. S.), and there is no reason to doubt that if it should prove desirable to refuel at even greater flight speeds, the equipment could be readily modified to make this possible.

An interesting and useful aspect of the Receiver equipment, as fitted in airliners, is that it is quite simple, takes up very little space, and weighs little more than 300 pounds. It merely comprises the reception coupling in the stern ; a pipe-line from the coupling to the fuel tanks ; a hauling line with which to haul in the hose ; and a windlass for hauling the line. In the earlier experiments the windlass was hand-operated ; now the drum is power-driven from the normal hydraulic services of the aircraft, as are the hose drum unit, contact line winch, and the fuel valves in the Tanker. In both Tanker and airliner, the power is taken from the aircraft system through a changeover cock in the pressure line between the engine pumps and the automatic cut-out. A micro-switch on the cock lights a red lamp in the flight engineer's panel immediately the selector lever is moved to the ' refuelling ' position, the lamp remaining lit until ' general services ' is selected at the end of the operation.

Of unusual interest is the reception coupling, which is a bell-mouthed unit fitted in the stern of the airliner (Fig. 8). Its principal function is to house the ball-end of the hose nozzle, and a fuel-tight joint is made by means of four hydraulically operated toggles which grip the nozzle lip and press the nozzle against neoprene seals. The coupling and hose nozzle then form a complete fuel reception unit, which is secure and fuel-tight. In order to allow the hauling line to pass through the centre of the coupling, the fuel line is bifurcated at the throat, and from the reception coupling the hauling line is led to the windlass through a conduit tube to prevent fouling within the aircraft. Each of the two branches of the fuel line embodies a fuel flap-valve

Fig. 7. The reception coupling faired into the stern of the Lancaster. Note the end of the hauling line with its bayonet coupler.

which is operated hydraulically by a jack in conjunction with the toggle in the reception coupling. When the hose nozzle is held by the toggles, the flap-valves are open, permitting the passage of fuel ; when the toggles are disengaged, the flap-valves automatically close and seal the pipe-line.

Provision is made within the coupling to permit release of the hose if a heavy drag is imposed upon it. This drag imposes a tension on the toggles from the hose nozzle, tending to force the pistons up the jacks, and imparting more pressure to the fluid, through the pipe-line to the automatic release valve. At a tension in the hose of 1,400 lb., the pressure in the fluid is sufficient to cause the automatic release to blow off, thus releasing the pressure in the system, and, by opening the toggles, permits the hose nozzle to disengage. This is important in very bumpy weather, or in conditions which necessitate an emergency break-away ; in fact, the freedom of action of both aircraft is unrestricted from start to finish. No damage to aircraft or to equipment will result, and refuelling contact can be re-established with ease. The break-away tension is not great enough to affect the flying characteristics of either aircraft.

The equipment of the Tanker is of necessity a good deal more comprehensive. In the Lancaster used as a Tanker, there are two cargo fuel tanks, each of 600 gallons capacity, installed in the forward part of the bomb-bay. By using the No. 1 aircraft main fuel tanks as fuel tanks in addition, it has become possible to transfer 2,000 gallons of fuel from the one Tanker. The tanks are interconnected and also, of course, the main fuel line is connected to the hose drum unit. Since the drum has to rotate, to pay out and wind in the hose, the connection from the tanks is to a revolving joint which is part of the axis of the drum. The drum is driven by and geared to an hydraulic motor, and is positioned in the after end of the bomb-bay (Fig. 9). The hose pipe is 250 feet long, and has an inner bore of 2 inches. It is of petrol-resisting rubber, reinforced with a woven sheath and bonded with a spiral of steel wire, and has a breaking strength of nearly 6,000 lb. At the free end of the hose pipe is the large metal nozzle, which is shaped to form a fuel-tight joint with the cup of the reception coupling in the airliner.

Fig. 8. Another view of the reception coupling, showing constructional details.

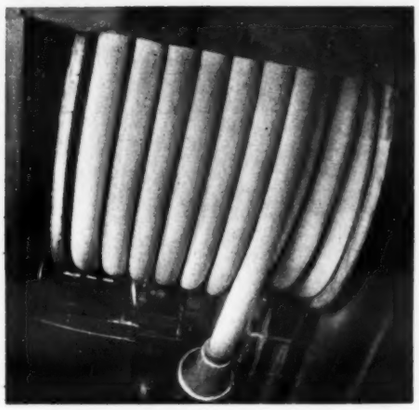


Fig. 9. The hose drum unit and hose pipe, positioned in the backward portion of the bomb-bay.

The Tanker equipment, as is the airliner equipment, is operated by one operator. The airliner and developments are in hand to make the operation from the airliner entirely automatic.

Certain safeguards are incorporated, particularly concerned with the elimination of any fire risk. The possible difference in the electrical potentials between the aircraft before contact is equalised on the bared section of the hauling line on initial contact with the contact line, at a safe distance of 200 feet from each aircraft. During the operation, the aircraft are bonded together through the earthed hose and the hauling line and its coupler, and the reception coupling. The whole fuel line from the main valve in the Tanker to the fuel tank vents in the airliner are inhibited after the hose is connected, before the fuel is passed. To achieve this, the system is automatically flushed with nitrogen under pressure from the Tanker. Automatic valves guard against spilling and syphoning of fuel, and collapse of any part of the hose due to too great a difference in the internal and external pressures, while to prevent flooding of the airliner tanks, each tank is equipped at the inlet with a special tank-filling valve which automatically shuts off the fuel flow when the tank is full.

The advantages of flight refuelling are many : it is capable of doubling or trebling the payload on established long non-stop stages ; permitting long non-stop stages where they are impracticable without refuelling in flight ; assisting take-off and climb with safety carrying full payload ; and providing reserve fuel in the air when required. Enough has been said to show that these advantages are not theoretical in the sense that they depend upon the successful completion of development of the scheme ; refuelling in flight is no longer a project under development, but a proven, and, in many ways, a necessary auxiliary to successful airline operation.

Book Review

Construction des Avions.

By G. du Merle, ingénieur en chef de l'Air. Published by Dunod, Paris, 1947.

The author's aim is to provide the technically-minded reader with a comprehensive picture of aeronautics in its present stage, as regards the aeroplane proper. Basing his account on existing constructions, he describes the aeroplane as a whole, then its unit components, parts and equipment, from the aerodynamic, static, constructional and manufacturing standpoint, without recourse to higher mathematics. In place of mathematical formulae, du Merle uses easily-understood descriptions in the formulation of his conclusions, each problem being treated in minute detail.

This second edition has been subjected to thorough revision in order to cope with the technical progress achieved since the publication in 1942 of the first edition. Certain chapters deal with the more recent problems of jet propulsion, pressurisation, anti-icing, etc. A short glossary is provided for readers who are not entirely familiar with aeronautical terminology. Its value as an outstanding work of reference is enhanced by a collection of photos and drawings of the best-known modern aircraft. It comprises 856 pages, with 553 illustrations and 2 sectional drawings ; Price : Fr. fr. 2,350. (French.)

F. P.

Théorie des Ailes Monoplanes d'Envergure Finie.

By Prof. Elie Carafoli. Printed and published by M. O., Imprimeria Nationala, Bucharest.

Aerodynamic calculations on all wings except those of elliptical periphery are confronted with considerable difficulties, as the variable and constant values in this connection have hitherto not been made available in explicit and comprehensive form.

Prof. Carafoli endeavours to bridge these difficulties in a simple manner, and deals with the problems of spanwise distribution of lift, total drag, air force moment, the deformations caused by the air forces reacting on the wing, and the theory of ailerons ; general solutions are provided in the form of relatively simple mathematical expressions. The book is a valuable supplement to the existing literature on the subject. (French.)

Ba.

The German Air Force.

By Wing Commander Asher Lee. Published by Duckworth, London, 1946.

The author was on the air intelligence staff of the Royal Air Force from 1940 to 1945 as the Air Ministry's leading specialist on the German Air Force. With sources of information at his disposal which are only available to a high official of a well-organised intelligence service, he describes the birth and development of Goering's instrument of power with exceptional objectivity. Asher Lee's book provides the most comprehensive description of the G. A. F. and its operation published since the war.

The first chapters, describing the birth and the organisation as regards personnel and equipment, form the most significant part of the book and a valuable work of reference for students of aerial warfare questions. Less clear are the chapters in which the author deals with the strategic and tactical aspects of the operations on the various fronts.

It is a valuable book, and after reading it, one regrets that the author has confined his account to a little less than 300 pages. One feels that if he had made more use of the sources at his disposal, the book would undoubtedly have gained in value. (English).

Bi.

Official Bulletin of the F.A.I.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE, PARIS

1. *General Meeting.*

National Aero Clubs are requested to inform the *Secretariat-General* of all matters they desire to include on the agenda of the General Meeting, by *June 17th, 1947*, three months before the meeting, in order that all member clubs may be informed of these matters within the delay stipulated by the statutes.

Additionally, we request the National Clubs to forward the *accounts of their activities* for 1946 as soon as possible to the *Aéro-Club de Suisse*, to enable the General Report to be completed on time.

2. *Calendar of Events for 1947.*

According to information received up to April 21st, the calendar (cf. "Interavia," Vol. II, February, 1947) may be completed as follows :

June 20th-21st : Air Rally, Derby, England.
July 2nd, 3rd and 4th : Air Rally, Le Zoute, Belgium.
July 19th, 20th and 21st : Air Rally, Brussels, Belgium.
July 26th-27th : Air Rally, Elstree, England, with subsequent air demonstration at Elstree aerodrome.
August 30th-31st : International Air Meeting at Lympne Airport, Hythe, Kent, England, organised by the Cinque Ports Flying Club and comprising the following events :
Folkestone Air Trophy Race (International).
Lympne High Speed Handicap Race (International).

3. *Membership of National Aero Clubs.*

As decided at the London Conference and the Paris meeting of the General Council, membership of the following national aero clubs have been renewed :

Aero-Club d'Italia (Italy), via Cesare Beccaria 35, Rome.
Suomen Flygförbund R. Y. (Finland), Mannerheimintie, Helsinki.
Aero-Clubul Regal al Romaniei (Rumania), B-dul Lascăr Catargi 54, Bucharest.

4. *Customs Carnets.*

The Royal Aero Club of Sweden reports that Customs Carnets have been reintroduced in Sweden. The club has taken steps to renew reciprocal agreements previously concluded with other countries, and up to March, 1947, had done so with Denmark, England, France, Holland and Switzerland.

5. *Extract from the Regulations for International Gliding Records.*

Of the new regulations which came into force on April 1st, 1947, may be listed the following :

A. *Two categories of glider* are recognised :-
Category I : *Single-seaters* ; Category II : *Multi-seaters.*

B. *The following types of record are recognised :-*
1. Distance.
2. Out and return.
3. Goal flight.
4. Height.
5. Duration.

C. *General Regulations :-*

The Chief Pilot is responsible for submitting a claim to the national official organisation, enclosing the necessary documents, and, where possible, flying maps. Claims are to be submitted within eight days of landing.

THE MONTH IN REVIEW

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POLITICAL

● Air Vice-Marshal (retired) Douglas Collyer has been appointed *British Civil Air Attaché* in Paris, and has taken up his post.

● The French National Assembly has passed the *Defence Budget for the second quarter of 1947*, totalling Fr. frs. 75,722,142,000 with frs. 6,500,000,000 allotted to the Air Force. The Air Force allocation comprises only 14 per cent of the total vote (against 30 per cent in Great Britain), and only allows for an Air Force establishment of one eighth of the total defence forces (against one third in Great Britain and the U. S. A.). — The supplementary appropriation to the *Ministry of Transport* includes Fr. frs., 4,500,000,000 payable to Air France, the Government-owned airline.

● CIVIL AVIATION AGREEMENTS have been concluded between the following countries : *Rumania and Hungary*, in Bucharest, on April 3rd ; *Argentina and Portugal*, and *Spain and Portugal*, in Lisbon ; *Greece and Sweden*, in Athens on April 8th ; *U. S. A. and Syria*, in Damascus on April 28th. — The Hungarian Cabinet Council and the Allied Control Commission have authorised the *Hungarian Ministry of Transport* to initiate negotiations for Civil Aviation Agreements with *France*, *Sweden* and *Switzerland*. — On April 19th, James M. Landis, Chairman of the U. S. Civil Aeronautics Board, arrived in Buenos Aires to discuss the *renewal of air traffic negotiations* with President Péron ; these negotiations were broken off in the autumn of 1946 as Argentina would not agree to free competition. Similar negotiations between Peru and Argentina fell flat in Buenos Aires on March 27th for the same reason.

NEW AIRCRAFT

● *First Flight*. The *Consolidated Vultee XB-46* experimental four-engined jet bomber, powered with four General Electric J-35 gas-turbine engines of 4,000 lbs. max. thrust, undertook its first flight on April 2nd from Lindbergh Field, San Diego. Piloted by E. D. Shannon, Chief of Convair's Flight Research Department, the flight served to ferry the aircraft to the U.S.A.A.F. experimental base at Muroc, where the aircraft is to be flight-tested.

Consolidated Vultee XB-46 experimental four-jet bomber.

● *First Flight*. The second prototype of the *Hughes XF-11* twin-engined photo-reconnaissance aircraft effected its first flight on April 5th from the factory airfield of the Hughes Aircraft Co., of Culver City, Calif. The aircraft was piloted by its designer, Howard R. Hughes.

● North American Aviation Inc. has developed a new single-seater carrier-borne jet fighter, the *North American FJ-1*, which has already gone into production. It is expected to equal, or better, the speed of the Lockheed P-80 "Shooting Star" jet fighter.

Hughes XF-11.

Martin XB-48 jet bomber.

Avro "Athena".

● A. V. Roe & Co. Ltd. is developing a single-engined three-seater trainer, the *Avro "Athena"*. It is powered with a 1,000-H.P. turbine-propeller engine (either an Armstrong-Siddeley "Mamba" or a Rolls-Royce "Dart") driving a three-blade c. p. airscrew. Span, 40 ft. 0 in. ; length, 37 ft. 10 in. ; height, 12 ft. 3 in.

Piasecki XHRP-1.

● Piasecki Helicopter Corp., in collaboration with the U. S. Naval Bureau of Aeronautics, has developed a new helicopter for the U. S. Navy, the *Piasecki XHRP-1*. Intended for transport and rescue purposes, it possesses two contra-rotating rotors (fore and aft), a fixed tricycle undercarriage, and has a fixed tailplane and end-plate fins. It can carry a two-man crew and eight passengers, or more than one U. S. ton of freight, and has a cruising speed of over 100 m.p.h.

● The Glenn L. Martin Co.'s *Martin XB-48* six-engined jet bomber prototype has been completed. It is powered with six General Electric J-35 jet engines, built under licence by the Allison Division. Top speed will be over 500 m.p.h.

North American FJ-1.

● Bell Aircraft Corp. is constructing a new rocket-powered experimental aircraft for supersonic speeds, the *Bell XS-2*, which, like the Bell XS-1, is not projected as a military type, but solely for research purposes. Completely constructed of steel, the XS-2 differs from the XS-1 by having a pronounced sweptback wing.

INDUSTRY

● The U. S. War Department has entrusted the *General Electric Co.* with a *rocket-research programme*. This work is to be carried out under the direction of Dr. R. W. Porter and is chiefly concerned with aerodynamics, rocket motor design, and propellants. Particular attention is to be paid to methods of control.

● The firms of the Italian aircraft industry have formed a committee for the standardisation of aeronautical equipment under the name of "*Univia*" ; its chief duty is to work out legal drafts in this connection, and to submit them to the authorities.

● *North American Aviation Inc.* suspended production of its "*Navion*" four-seater personal aircraft for a period of 30 days, starting April 15th, in order to make a market survey.

INDUSTRIAL PERSONALITIES

● *Edgar Granville* has been appointed *Chairman and Managing Director of Portsmouth Aviation Ltd.*, in succession to L. M. J. Balfour, who now becomes Vice-Chairman and Deputy-Managing Director.

● *The Glenn L. Martin Co.* has formed a Customer Relations Division, under the direction of *T. L. Taylor*.

● *Frederick V. H. Judd*, power plant technical engineer of Republic Aviation Corp., of Farmingdale, L. I., has been awarded the *Wright Brothers' Medal* of the Society of Automotive Engineers for 1946, for his development of a new method for designing air-cooled engine cowlings.

● *Samuel Stewart Bradley*, Chairman of the Board of the Manufacturers Aircraft Association, died in New York on April 9th, aged 78. He had headed the Association since 1917.

INTERNATIONAL ORGANISATIONS

● ICAO : The number of signatories to the *International Civil Aviation Convention* of Chicago is now 34, as six additional countries, Egypt, France, Greece, Holland, Iceland and Transjordan, have ratified the convention. — At the *European-Mediterranean Air Traffic Control Meeting*, which started in Paris on April 15th, representatives of twenty nations called for the

* Abridged extracts from Nos. 1292/93 - 1304 (April 10th to May 6th) of "INTERAVIA, International Correspondence on Aviation," an illustrated newsletter published three times weekly in four separate language editions, English, French, Spanish and German.

adoption of Area Traffic Control and not the "Corridor System" in use in America. This system, which will be put into effect by seven countries by October 1st, does not require aircraft to secure prior permission before crossing international boundaries.

● IATA : The first Meeting of the *Air Freight Sub-Committee* of the *IATA European Regional Traffic Conference*, which was held in Paris, recommended to the Conference the creation of a single category of freight, known as International Air Express, that freight rates should be entirely separate from passenger rates, and that there should be only one freight rate for both all-cargo and combined passenger-cargo aircraft. — At the semi-annual meeting on March 25th in Montreal of the *IATA Finance Committee*, a new international agreement to exempt international air carriers from payment of local fuel taxes was recommended. — At the meeting of the *Technical Committee*, which started on March 31st in Montreal, the following recommendations were made : the adoption of standard measuring systems ; that there should be no limitation on dimensions and landing weights for international airports, because future development is not to be foreseen. The number of technical sub-committees of IATA will be reduced from eleven to four, and will deal with operations, aids and facilities, engineering, and communications. The next half-yearly meeting will be held from September 1st to 11th, 1947, at Nice.

EXHIBITIONS

● The *International Aircraft Show in Utrecht* is to be held from July 10th to 20th, 1947, instead of from May 16th to 22nd.

AIR TRANSPORTATION

● All accommodation is booked up on westbound trans-Atlantic air services until the end of the summer ; eastbound services are fully booked up until July. The present 2,000 seats which are available each week will be considerably increased following projected service intensifications this summer.

● On April 15th, *British Overseas Airways Corp.* opened a new *London—Prestwick—Gander—Montreal* service with Lockheed "Constellations" ; one return flight is made weekly. On May 8th BOAC intensified its *London—New York* service from four to five return flights weekly. — *Scandinavian Airlines System*, the joint Nordic carrier, which has been operating five weekly return flights on its *Stockholm—New York* service since April 14th, will introduce a sixth return flight on May 16th and a seventh on June 16th. — The U. S. Civil Aeronautics Board has authorised *Sabena*, the Belgian airline, to re-open its *Brussels—New York* service ; it will be flown with one return flight weekly from June and two return flights weekly from July.

● According to a statement by Lord Knollys, Chairman of *British Overseas Airways Corp.*, the British Ministry of Supply's decision *not to obtain any more Lockheed "Constellations"* for BOAC will cause the airline's annual deficit to be considerably increased. Services will have to continue to be operated by flying-boats, of which the speed is only about half that of the "Constellation," for several years to come.

● *British Overseas Airways Corp.* plans to intensify its six-weekly *flying-boat services to India*, and to start a scheduled service between *England and Ceylon*.

● *British European Airways Corp.* is to intensify its *London—Paris* service from nineteen to twenty-eight return flights weekly on May 19th.

● On April 15th, *Italy opened domestic air services* ; the occasion was marked by a ceremony at Milan airport.

● On April 15th, *TARS*, the Russo-Rumanian airline, and *Marzovlet*, the Russo-Hungarian airline, started a scheduled service between *Budapest and Bucharest*.

● The summer timetable of the *Russian airlines* introduces *no new foreign services* ; the routes between Moscow and Berlin, Vienna, Budapest, Warsaw, Prague, Belgrade, Bucharest and Sofia continue to be operated as before.

● The Iranian Government has *turned down* a Russian proposal for the formation of *Russo-Iranian airline* company.

● The *American domestic summer schedules* include an increased number of services operated with four-engined equipment : *American Airlines* anticipate having twelve Douglas DC-6's in service by June 1st, whilst *United Air Lines* should have 35 of these aircraft in operation by the end of the summer ; *Transcontinental & Western Air Inc. (TWA)* is taking delivery of four Lockheed "Constellations" for its domestic services on June 1st ; since April 1st, TWA has eliminated the 10-percent surcharge on its fares for domestic services operated with these aircraft.

● *United Air Lines* is seeking permission to operate *airmail helicopter services* linking 32 communities in the Chicago area.

● *The 60 member airlines of the International Air Transport Association (IATA)* flew a total of 8,346,000,000 passenger miles and suffered 33 fatal accidents in 1946 ; this is equivalent to 28,314,000 miles for each passenger fatality. Forty-two companies had no fatal accident during the year.

● The three British Government-owned airline corporations are considering *withdrawing the provision of free ground transport* between city terminals and airports, and the *elimination of free meals during flights*. No free ground transport is provided for airline passengers in the U. S. A., but it is the usual custom in Europe.

AIRPORTS

● The U. S. Civil Aeronautics Administration reports that *La Guardia Field, New York*, was the *busiest airport in the U. S. A.* as far as airline operations were concerned. — *Harmon Field*, Newfoundland, is to be expanded into a *permanent peace-time facility* ; under the Anglo-American lease-lend agreement, the U. S. A. has long-term rights at this airport. — On April 21st *Shannon Airport* was officially made the *first customs-free airport in the world*. — An airfield for overseas traffic, capable of taking aircraft weighing up to 60 tons is to be constructed forthwith for the internationally-administered town of *Tangiers, Morocco*. — The Greek Government has purchased four American-built airfields in Greece for the sum of $ 44,000. — *Brussels-Melsbroeck* airport is to be developed at the cost of Belg. frs. 1,275,000,000, and will replace Brussels' Haren-Evere airport ; the latter will be given up. — Under a contract signed on April 17th, the *Port of New York Authority* will take over the *three major New York airports* of La Guardia Field, Idlewild Airport, and Floyd Bennett Field, from the New York City Authorities ; *Newark Airport*, New Jersey, will also be taken over by the Port of New York Authority on June 1st. $ 200,000,000 are to be spent on the first three fields during the next fifty years.

SPORTING FLYING

● The *Isle of Man Races* for light aircraft will be held from May 24th to May 26th, for the first time since 1939. They are being organised by Wing Commander R. H. Stocken, INTERAVIA United Kingdom representative.

● *Private flying* will be authorised for Americans inf the *U. S. Zone of Occupation* of Germany, as soon as adequate security measures are established.

● Twenty-three aircraft of members of the *Royal Aero Club of Great Britain* flew from London to Madrid and Seville, with over 100 members, to take part in an air rally at Seville from April 18th to 21st.

● *Ypenburg Airport*, the pre-war Dutch sporting centre near The Hague, which was wrecked by the Germans during the war, will be re-opened on May 17th.

● The Royal Aero Club of Belgium announces that the *first post-war international air rally* will be held from July 4th to 6th at Le Zoute airport, which was well known as a sporting flying centre up to 1939.

SERVICE AVIATION

● Under the Lend-Lease settlement, *South Africa* has received 50 transport aircraft and 120 single-engined trainers from the *U. S. A.* — 136 "Spitfire" fighters will be transferred from the *Royal Air Force* to the *South African Air Force* during the period up to November. A *Royal Air Force mission* has visited South Africa to inform the *South African Air Force* on the latest developments of jet fighters in Great Britain ; it is probable that the S. A. A. F. will re-equip its fighter squadrons with jet aircraft.

● The *Royal Canadian Air Force* has decided to introduce *DH-100 "Vampire"* jet fighters into service, following the successful conclusion of winter tests with this aircraft. — The *Portuguese Government* has acquired 150 surplus *R. A. F.* aircraft.

● An R. A. F. de Havilland "Mosquito" piloted by Squadron Leader H. B. Martin established a *new speed record* by flying from *London to Cape Town* in 21 hours 20 min. on April 30th.

● The *U. S. Naval Air Transport Service* flew some 68,000,000 aircraft miles during the four years ending January 1st, 1947, and only suffered one fatal accident during the whole period.

● The *U. S. A. A. F.'s Air Weather Service* has started a series of routine weather reconnaissance flights over the North Pole, using Boeing B-29 "Superfortress" four-engined bombers.

● On April 22nd the 18,300-ton British light fleet-carrier, *H. M. S. "Centaur,"* was launched at Belfast ; begun two years ago, her construction had been modified to take into account lessons learned from the war.

Erratum : Interavia, Vol. II, No. 3, March, 1947 : In the article entitled 'Laminar Flow Airfoils with Boundary Layer Suction,' the author wishes to insert on page 46, col. 3, line 24, 'jet' instead of 'ram-jet.'

PHOTO CREDITS :

Cover page : Manufacturers ; P. 12-15 : Author and Interavia Archives ; P. 16-21 : TWA (14), Photopress (1), Interavia Archives (1) ; P. 22-23 : Interavia Archives ; P. 24-25 : IATA ; P. 32-35 : Manufacturers ; P. 36-39 : Barratt's Photo Press Ltd. (3), Central Press Photos Ltd. (1) ; P. 40-42 : Author ; P. 44-45 : ATF-Archives (1), Photopress (2) ; P. 46-47 : Interavia Archives (10), ATP (4) ; P. 49 : Interavia Archives ; P. 50-51 : Martin & Kelman ; P. 52-55 : Author ; P. 57-58 : SAE (1), Manufacturers (6).

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